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The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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## Contents

| | PAGE |
|---|---|
| Machine Lighting | 53 |
| Permanent Moulds in the Bronze Age | 53 |
| Correspondence | 54 |
| New British Chemical Standards | 54 |
| Publication Received | 54 |
| Random Shots | 54 |
| Sandblasting | 55 |
| High-Duty Cast Iron in the Foundry | 57 |
| Catalogue Received | 58 |
| I.B.F.: Election of New Members | 58 |
| Defects in Iron Castings: Their Cause and Cure | 59 |
| United States Steel Industry | 62 |
| Permanent Set and Elastic Hysteresis in Cast Iron | 63 |
| Activities of the English Electric Company in 1934 | 66 |
| This Week's News in Brief | 68 |
| Trade Talk | 68 |
| Contracts Open | 68 |
| New Companies | 68 |
| Personal | 68 |
| Obituary | 68 |
| Company Report | 68 |
| Raw Material Markets | 70 |
| Patent Specifications Accepted | 70 |

## Machine Lighting

We were distinctly impressed by a letter which we received from Benjamin Electric, Limited, on a phase of lighting which we confess had not hitherto been brought to our notice. It seems that an Indian engineering concern had bought a British machine and asked for a scheme to be prepared for its adequate illumination. This sensible and simple request raises a point of very great import to both foundry owners and our advertisers. When people are constructing machinery they devote time and thought to its adequate lubrication, to facility of general operation, handy positioning of its loose tools and so on, yet how many have given one moment's thought to the proper illumination of working tables or space? Those firms which, when supplying machines, point out that the general illumination of the shop should be so many foot-candles, whilst for the proper function of the machine local additional lighting should be provided at certain points indicated and recesses or brackets be provided for ease of installation, will be ahead of their competitors.

This sort of service is one that is greatly esteemed by the customer, as it shows immediately that the supplier has some knowledge of his customer's problems. It may save him considerable expense in experimental lighting which, even when it is accomplished, may detract from the appearance of the machine, as festooned flex invariably looks untidy, especially when associated with home-made brackets.

A neat oiling system such as we saw only last week on a huge press—the product of a Tyneside foundry—places in unfavourable relief the lack of a similarly neat lighting system, which one would like to see incorporated in moulding machines by the designers. We feel so keen on this particular phase of illumination that we would suggest that, not only should the machine leave the designers' works properly wired for its local lighting, but that the actual lamp-holders and bulbs should be included as standard equipment. It is this type of improvement which not merely helps to sell the machine, but also materially aids its economic functioning.

## Permanent Moulds in the Bronze Age

A recent discovery in Cornwall bids fair to throw entirely new light on the history of the Bronze Age, and one in which foundrymen will be keenly interested. This is nothing more or less than a mould fashioned in stone for making axe heads, obviously in the cast state. It has hitherto been supposed, and doubtless historians will correct and amplify our statements if they are wrong, that following the Stone Age, in which all weapons and utensils were fashioned in stone, there occurred the Bronze Age. Probably somewhere there occurred native ores of copper and tin sufficiently near the surface of the earth to be turned up by a primitive plough, and, when submitted, possibly accidentally in the first place, to the heat of a fire, the metal had a sufficiently low melting point to run off and form a primitive ingot. It has generally been held that the bronze, being malleable, was shaped by tools, doubtless of stone, to whatever purpose the men desired, after being made in a primitive wind furnace.

Towards the end of 1934 a workman employed at a quarry at St. Teath, Cornwall, excavated two hollowed out stones, each half bearing the form of a battle axe. The pieces formed the top and bottom portions of a stone mould, made five thousand years ago. The mould has in fact been used recently to cast a white metal axe-head, which bears the decoration on the original mould. It should be said that the stone of the mould is what is called freestone, a softer stone than that of the quarry in which it was found. It is about five inches by three inches and weighs about six pounds. The quarry was only opened in April, and the mould was twelve feet below the surface, in a kind of cave, which is being explored for further finds. It may be that a soft stone had to be used for the mould in order to make it possible to work with a harder stone as a tool. We have been promised a photograph of this remarkable example, which is a silent witness to foundry craftsmanship across fifty centuries. It should appeal to all foundrymen, who will no doubt await further information with interest.



XUM

## Correspondence

*[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]*

### The British Industries Fair

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—Before I leave for a business visit to South Africa, may I say a word with reference to the forthcoming British Industries Fair.

Great Britain's comparative prosperity among the manufacturer nations is accepted on all hands to-day as a fact of Nature like the rising of the sun.

But if our privileged position is to be maintained and strengthened, we cannot too often be reminded that prosperity, in common with most other benefits worth securing, is the result of planning and constant work.

Such a reminder arrives appropriately in these early weeks of a new year with the announcement of the nations sending most buyers to the British Industries Fair, which opens in London next month. They coincide almost exactly with the list of countries which increased their imports of British goods during the first nine months of 1934. We sent more goods to Holland, Denmark, Italy, Belgium, Sweden, Norway and Switzerland, all of them countries from which large numbers of buyers will arrive in London in February, and in Birmingham when the Engineering and Hardware Section opens in May.

Our Fair, in short, is a fine example of results to be gained for British manufacturers, and their workpeople, by intelligent planning and steady work from year to year, and the Fair is, in my opinion, worthy of the support of all those connected with the industry and commerce of the country.

We can with profit study the method of its achievement and refrain from taking prosperity for granted.—Yours, etc.,

H. MCGOWAN, Chairman.
Imperial Chemical Industries, Limited,
Millbank, Westminster, S.W.1.
January 12, 1935.

### The Oldest Grey Iron Casting

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—In connection with the interesting letter in your issue of December 20, 1934, from the Past-President, I.B.F., a statement is made in Moldenke's "Principles of Iron Founding," which I have never seen repeated elsewhere:—

> "We have record of a bridge with cast-iron chains being built in Japan in the year A.D. 70. Pausanias speaks of cast iron statutory introduced by the Samnian Theodorus a century later."

This statement, if authentic, throws back the date of the oldest piece of cast iron by thirteen or fourteen centuries. One can hardly view the manufacture of a cast iron chain as an "accidental" production!

T. L. MATHIAS.

148, Meols Parade, Gt. Meols, Cheshire.
January 7, 1935.

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FIFTY YEARS AGO Mr. Peter Burt founded the Acme wringer factory in Glasgow. He used a small shop and a handful of men to produce the first wringer. Increased sales have been reported almost every year since then. Sales have increased by 27 per cent. during 1934. A staff of 500 are producing 1,000 wringers every day. An important extension scheme has now been launched, which will cost £50,000 and lead to a staff increase. Two additional acres of floor space, packed with the most modern plant available, will be provided.

## New British Chemical Standards

As a result of a request for standard analysed samples of ferro-alloys, the Headquarters of British Chemical Standards announces the issue of the first three of a new series, viz.:—

Ferro-tungsten (80.7 per cent. tungsten).
Ferro-molybdenum (72.1 per cent. molybdenum).
Ferro-titanium (22.8 per cent. titanium).

These alloys are in each case of the low-carbon variety, and have been analysed by a ferro-alloy manufacturer, independent chemist, and Sheffield works' chemists. There is no doubt that they will meet a want long felt by chemists associated with manufacturers and buyers of alloys for special steel making. The standard samples are issued in bottles containing 25 and 50 grms. of each alloy, at a price which it is estimated will eventually cover the cost.

A valuable feature is the certificate of analyses which accompanies each bottle, and gives not only the individual tests and the standard figures, but also an outline of the methods of analyses employed. This information is of particular value in the case of the ferro-tungsten. The samples may be obtained direct from Headquarters, 3, Wilson Street, Middlesbrough, or from any of the usual laboratory furnishers.

## Publication Received

**Recommended Materials for Machine and Hand Tools. (A.A. 5).** Published by the Bureau of Information on Nickel, Thames House, Millbank, London, S.W.1.

We greatly esteem this series of pamphlets, because properly used, they should, as tentative specifications, represent a very fine basis upon which to build worth-while knowledge, and which eventually can be taken to the B.S.I. with ascertained knowledge and practical experimental evidence, so that data for future specifications will be drawn from wider fields. If we were in charge of an iron or steel foundry we should certainly try out the compositions recommended, and make the fullest comparison with existing ones, if they happened to be different. There may be a price increase, as the compositions recommended all contain nickel, but a *billet doux* to a client saying "we are taking the liberty of sending you an alloyed casting to your pattern No. 13, and should be glad if you will test it against the rest of the batch. Naturally, these castings are somewhat more expensive, but in view of their enhanced mechanical properties it may be to our mutual advantage to co-operate in this matter." It is only by such methods as this that cast iron can be put on the high plane which the results of modern scientific investigation have acquired for it.

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CONTRIBUTIONS to charitable institutions for 1934 have been made by employees of various firms, as follow:—Anderson, Boyes & Company, Limited, Flemington Works, Motherwell, £215 19s.; William Baird & Company, Gartsherrie Ironworks, £191 7s. 4d.; Coltness Iron Company, Limited, £4,020 6s.; Archibald Baird & Company, Limited, Clyde Steelworks, Hamilton, £111; Grangemouth Dockyard Company, Limited, £111 5s.; Dobbie Forbes & Company, Limited, Larbert Foundry, £123 2s. 1d.; Smith & Wellstood, Limited, Bonnybridge, £550 11s.; R. & A. Main, Limited, Gothic Ironworks, Falkirk, £407 1s.; Messrs. Colville, Limited, Glengarnock Steelworks, £763; Messrs. Blairs, Limited, Govan, Glasgow, £212; James Howden & Company, Limited, Glasgow, £200; Babcock & Wilcox, Limited, Dumbuck Works, Dumbarton, £184; Hardie & Gordon, Limited, Levenbank Foundry, Dumbarton, £23; British Ropes, Limited, Rutherglen, £90.

## Random Shots

If there is one thing more than another which reveals "Markman's" real inferiority complex it is being handed a contract and being shown just where to sign on the dotted line. After last Friday's show at the Royal Vic in Sheffield, when the Refractarians disported themselves at full strength in their war paint, "Marksman" has been cured, and in future dotted lines will be associated with dotty evenings and red tape with painting the town "red." This is the contract:—

* * *

**A Contract** made this eleventh day of January, nineteen hundred and thirty-five, between "Marksman" (hereinafter called the GUEST) of the one part and the Refractories Association of Great Britain (hereinafter called the HOST) of the other part.

**Whereas** the HOST is desirous of providing certain enjoyment and refreshment and has caused a Specification to be prepared with that object and whereas the GUEST is entitled to a full evening's pleasure and amusement and to enjoy $\frac{\text{her}}{\text{him}}$self according to $\frac{\text{her}}{\text{his}}$ mood and desire, to eat, drink, and otherwise be merry, and to disport within the limits and precincts described in this said Contract and upon certain terms and conditions prescribed therein.

**This Contract** is valid only for the eleventh of January, 1935, from the hour of 7 p.m. until 2 a.m. on the following morning, wherein there shall be much gaiety as is afforded by the rattling of dishes, the popping of corks, the chinking of glasses, the telling of stories, the laughter of ladies and the lightsome shuffle of many merry feet upon the polished maple.

**This Contract** imposes upon the HOST the obligation of providing the wherewithal for such jollification as is described above and upon the GUEST the obligation of doing $\frac{\text{her}}{\text{him}}$self extremely well in accordance with the schedule and the conditions of the Contract as hereinafter defined.

* * *

After this followed details of the menu, cabaret, prize awards, and the detailed clauses of the contract, the best of which reads:—

(4) This Contract is liable to cancellation in cases of premature drowsiness, sliding under the table, dancing to the common danger, exceeding the speed limit, parking in other than official places, violation of the one-way traffic regulations, impairment of speech before 9.30 p.m., inquiring the time—any time, talking "shop," and playing puss-in-the-corner.

* * *

In general the representatives of the foundry industry did themselves proud. Professor Andrews dolled himself up as a cross between pierrot and clown, Mr. Barrington Hooper was magnificently attired as a Venetian nobleman, Mr. V. C. Faulkner merely wore his Sunday clothes, a velvet jacket, a silk shirt, a spotted floppy tie, and called himself an artist as he had a beard and some side whiskers. Young Mr. Bert Winterton looked like a pre-war officer of the militia, requiring a nurse girl to complete the picture. Mr. F. S. Russell, as a cavalier, won, as indeed he deserved to do, a first prize. To describe the ladies' frocks would require a "Markswoman," though that of the first prize winner, Miss Silly Symphony, could be done by the office boy—a spot of organdie and a smile. It was a really good show, and the floor was just as crowded at 2 a.m. as it was at 9 o'clock. For his sins, "Marksman" attends innumerable gatherings organised by technical and business associations, but never has he had such a wonderful evening as was organised by the Refractories Association.

MARKSMAN.

# Sandblasting*

By Kenneth Hill

The origin of sandblasting is uncertain. It is pleasing to believe, however, as it is sometimes claimed, that an observant traveller saw commercial possibilities in the action of sand blown across the face of the Sphinx, but whatever its origin, there can be no doubt that to-day it has grown into a vast labour-saving industry.

Sandblasting is the discharging of abrasive material, under pressure, against surfaces to be treated. This treatment is of many and varied kinds, indeed, the many uses to which a sandblast plant is put to-day are too numerous to itemise in this Paper, and years of experience have proved the advantages and economies of sandblasting too firmly to admit any argument.

Some of the more common uses are the treating of all metals, whether castings, forgings, sheets or structural shapes, such as the cleaning of castings in foundries, of forgings to remove scale, surfacing of metals prior to painting, enamelling (either vitreous or synthetic), plating, galvanising, rustproofing or sherardising, the cleaning of ships' hulls, the matt-surfacing of metals, roughing handles or instruments and tools, renewing old files, lettering or frosting of glass, lettering of marble, producing a rustic effect on the surface of building bricks and blasting wood to bring out the grain and give an appearance of antiquity, and there are many other applications.

The discharge of abrasive is usually through a nozzle and the manner of application to the material to be abraded is of many forms to meet varying conditions and requirements. The pressure commonly employed is supplied by compressed air, though steam is used in some of the more remote operations.

Some little time ago, American engineers revived the principle of the application of centrifugal form to supplant the use ef such a costly medium as compressed air, and after some years of investigation and experiment have evolved a machine giving excellent results, to which reference will be made later.

### Systems Generally Used

The power of the compressed air to discharge the abrasive is applied by three general methods: (1) the direct-pressure system; (2) the suction or syphon system, and (3) the gravity system.

In the direct-pressure system the air and abrasive are combined in and discharged from a sealed container through a single nozzle, and the commonest example of this is the hose sandblast of a closed hopper type. It will be noted that the abrasive already under pressure in the chamber of the machine is discharged in combination with the air at gauge pressure, thereby obtaining the highest possible velocity. Thus it will be easily understood that this is the best system of sandblasting for the vitreous-enamelling trade.

In the suction or syphon and gravity systems the abrasive is introduced into the air stream at or near the point of combined discharge, and thus the delivered pressure is below gauge indication, with consequent decreased velocity. The sandblast barrel is a typical example of the last-named system.

### Basic Considerations

The following basic facts govern, generally speaking, all forms of sandblasting:—Size, type or system of the sandblast machine is no factor in the volume of the air flow, which is entirely governed by the size of the nozzle opening and the maintained pressure; hence, if the nozzle opening increases with use, the volume of air flow increases or the pressure drops. The air pressure should be maintained to secure the maximum economy in cleaning, and must, of course, be adapted to the ability of the material to withstand the impact of the abrasive.

As a general proposition, all other factors being equal, the higher the pressure the greater the cleaning capacity. Twice as much work is accomplished at 50 lbs. pressure than is at 24 lbs. pressure and at 60 than at 30.

Compressed air contains moisture, which must be removed before delivery to the sandblast to prevent dampening of the abrasive, with consequent clogging and other troubles. The flow of compressed air through a round orifice or nozzle opening at varying pressures, together with the power required to develop same, is supplied by all compressor-plant makers. The speed of the compressor governs the volume of air supplied by it, and, as a certain horse-power is required to compress one cub. ft. of free air to a specified pressure, the speed of the compressor, in addition to regulating the volume of air compressed, also governs the amount of horse-power required. This allows one to operate a compressor of greater capacity than is required for immediate needs at a reduced speed, with correspondingly reduced horse-power. Thus, additional air is available, when required, by speeding up the compressor to its rated capacity.

For the ordinary plant requiring not more than 300 to 400 cub. ft. of air, single-stage compressors will be found quite satisfactory, either of the vertical or horizontal type. Where greater volumes of air are necessary, two-stage compressors are more economical. In determining the size of compressor to instal, one should anticipate the entire requirements of the plant and make reasonable allowance for added equipment.

In the vitreous-enamelling trade, there are three types of sandblasting equipment generally in use in this country, *i.e.*, the steel room, the cabinet and the rotary table. In a few isolated cases, satisfactory blasting is being accomplished in a barrel-blast plant, but results are not sufficiently consistent to warrant any confidence in this type of machine.

Of the above-mentioned three types, it has been found, on investigation, that the steel room is the most popular, closely followed, and soon to be superseded in popularity, by the rotary table.

### Sandblast Chambers

Steel rooms are built in sizes and designs to meet all conditions and kinds of work, and should be rubber lined, halfway up the inside walls. Generally speaking, a sandblast-room installation consists of five parts:—(1) The blasting chamber or room; (2) the blasting unit; (3) the abrasive separator; (4) the dust collector and fan; and (5) the abrasive handling system.

The first four items are standard, generally speaking, but the fifth, the abrasive handling system, is of three distinct types:—(*a*) Gravity, (*b*) pneumatic and (*c*) mechanical. *The gravity system*, as the name implies, makes it necessary to place the blasting unit below the floor hopper to permit the entry of returning abrasive by gravity. This necessitates a deep pit. *The pneumatic system* depends upon the velocity of all or a portion of the ventilating air to carry the abrasive from the floor hopper, in a pipe, up into the separator placed above the blasting unit. *The mechanical system*, in personal opinion, is, and has proved itself to be, the most dependable and economical, as this system, unlike other types, handles all weights, grades and sizes of sand, flint or metallic abrasive without any change or adjustment. The used abrasive falls through perforated floor plates into a hopper, whence it is taken, either by a spiral or a belt conveyor, to the boot of a bucket-belt elevator which raises it to the top of the abrasive separator for re-use. Power requirements are low with this method of handling, and so are its operating expenses.

The operating cycle of the sandblast room, which works on the direct pressure system, is too well known to necessitate repetition, but it is suggested that a considerable saving in costs may be effected by fitting a rotative table to the wall of the room, half within and half outside. As the operator cleans the work within the room, a labourer can load the exposed half with castings to be cleaned; a half-turn of the table brings the new load into the room for cleaning and exposes the cleaned work for unloading and for re-loading. An upright partition is necessary. A more widespread adoption of this suggestion would reduce the interruption of blasting to a minimum. A room might conceivably be equipped with an overhead monorail, which not only provides transportation, but support for the work whilst being blasted, without re-handling.

### Rotary Tables

The rotary table has a blasting system of either the direct-pressure type or the gravity-feed type, according to the type of work to be cleaned. In the vitreous-enamelling trade again the bulk of the work to be cleaned has such a hard surface that it is economical to use the most intensive blasting action possible, which is direct pressure. The rotary table is usually entirely self-contained, is automatically continuous, and operates on the direct-pressure principle. Three operations are performed by integral units of the table, each fully co-ordinated: (1) the movement of the work; (2) the sandblasting operation, and (3) the separation and reclamation of the abrasive for re-use.

Approximately one-third to one-half of the table area is exposed for loading and unloading the work. The remainder is enclosed by a steel housing usually protected from abrasive wear by renewable rubber lining. As the table rotates, work passes to and from the blasting zone through multiple rubber curtains which confine the flying abrasive and dust to the blasting area. The abrasive and foreign particles drop through the grates in the table top and the dust is carried away by an exhaust system to a dust collector.

Again, an American firm of sandblast-plant manufacturers have recently evolved a new type of rotary table which handles efficiently all sizes and types of castings for coal, gas and electric ranges and cookers and fires. Perfect surfaces for both wet- and dry-process enamelling are secured without any touching-up of sides or edges. For such work it has a three-machine capacity, equal to a small table, a room and a barrel. They claim that a great variety of shapes and pieces can be handled at the rate of 11½ cwts. per hr. with a perfect surface for enamelling. Japanned or commercial work is cleaned at the rate of 24 to 30 cwts. per hr.

The four nozzles are set at an angle of 90 degs. from each other and inclined towards the centre at an angle of approximately 60 deg. and to the sides at an angle of 5 deg. The blast streams thus converge to a common point on the table top, which assures reaching the sides and even slightly-undercut surfaces of the work. Ability to clean vertical, as well as horizontal faces, is an exclusive feature of this type of rotary table.

### Sandblast Cabinets

To meet a preference for removing the operator from within the sandblast enclosure, the cabinet or table cabinet is used, making possible the cleaning of rotary-table or room size work without serious sacrifices in production speed. By a practical method of blasting from the outside, through a slot in the cabinet wall, the operator escapes contact with flying abrasive or dust-laden air and can work without special head

* Paper read at a meeting of The Institute of Vitreous Enamellers in London, Mr. B. B. Kent presiding.

covering or protective clothing, with the exception that he does require a pair of either long gauntlet rubber gloves or gloves with separate gauntlets. Generally speaking, the principle of the action of a cabinet-type plant is similar to the room plant.

### Centrifugal Sandblast Plant

Regarding the principle of the application of centrifugal force referred to previously in this Paper, two firms in America have evolved a centrifugal-force blasting machine, but, so far, the application of such force has only been perfected in the barrel type of plant. Experiments are being carried out and the author has been given to understand that one of the firms has succeeded in adapting the wheel to a rotary table and room.

The main points of superiority of the centrifugal-blast machine or wheelabrator over all other types of sandblast plant are as follow:—

(1) The lowest cleaning cost, because of highest blasting efficiency, and lowest maintenance.
(2) No compressed air. Centrifugal-blast unit of heavy construction for longest wear.
(3) Double-tumbling action under the blast stream on every piece of work.
(4) Easy loading. The loading point is lower than any other machine.
(5) Easy unloading. Load flows into tote box by reversing travel of drum.
(6) Positive cleaning of abrasive; all wires and oversize material removed by non-clogging, self-cleaning screen wheel. All dust and fines removed by air wash.
(7) Lowest maintenance, because all parts exposed to blast action are of abrasive-resisting material and of extra heavy construction.
(8) Lowest headroom of any machine of equal capacity.
(9) Power-operated doors.
(10) Accessibility. All drives and bearings thoroughly protected from dust and abrasive but easily inspected.

Unfortunately, there is only one machine of this type at the moment in this country, and that has not yet been put into operation. The producers of this type of machine, however, claim that it will clean 1,800 lbs. of castings in 8 mins. of blasting, or 18 cub. ft. For the vitreous-enamelling trade, the barrel type, however, is of little use, for obvious reasons.

### Clean Abrasive Essential

In all types of sandblasting plant used for the cleaning of castings for vitreous enamelling, the installation and use of an abrasive separator and cleaner is unhesitatingly advised, as failure to free the abrasive from "metallic smudge," erroneously called "graphitic carbon," will eventually produce poor enamelling, with consequent losses. An abrasive separator can be fitted to almost any type of sandblast plant, and one at least has only one moving part and one pneumatic adjustment for air velocity.

The entire mass of abrasive and refuse is discharged from the elevator spout into a revolving screen, where the coarse refuse is removed, and the remainder drops on to sloping plates, which distribute the abrasive evenly along the top edge of an inclined plate, positioned at an angle greater than that of repose. This plate delivers the abrasive past an air-washed nozzle, where the material stratifies, *i.e.*, the heavier or good material arriving at the top and dropping through the air wash to the abrasive storage below. The fine refuse settles at the bottom of the case against the inclined plate, and as the pneumatic wash of the air nozzle passes the cascading material, this fine refuse is carried off to the dust collector.

### Wear of Nozzles

How many enamellers realise that the small inexpensive nozzle is the part that controls the amount of energy that must be supplied from the compressor, and, further, that nozzles are the smallest part of a sandblast plant, yet probably are the largest factor in determining the net cleaning cost?

Nozzles are subject to wear at both the inlet and outlet orifices, each having its peculiar influence. Maximum efficiency is obtained only when the abrasive stream is concentrated, while the efficiency is decreased whenever the nozzle has worn to a point where the abrasive stream is spread over too great an area. Nozzles worn beyond the limit of good practice are an added expense in cleaning, as they increase the total cleaning costs by many times the price of new nozzles.

The right time to change a nozzle is when the outlet has worn to such an extent that the abrasive stream is spread out too much, extending the time of blasting out of proportion to the flow of compressed air and abrasive. Wear of the nozzle also is influenced by the kind of abrasive used; the lighter the abrasive particles, the greater will be the side thrust and nozzle wear. It is interesting to note that plants using sand or flint as their abrasive, generally speaking, use about six times as many nozzles as similar plants using metallic abrasives, because the latter are about two and a-half times as heavy as equal volumes of sand or flint, and, in consequence, resist the side thrust to a greater degree.

Outlet wear is caused by the side thrust of the abrasive against the walls of the nozzle, as the compressed air expands in the atmosphere. The nozzle wear is in the shape of a cone from the inlet through its entire length. This causes the abrasive stream to spread and causes a serious loss in production. Inlet wear governs the volume of compressed air flowing through the nozzle and, unless the abrasive flow can be increased proportionately with such wear, the increased compressed airflow represents a loss. It is a good thing to remember that the nozzle is a small inexpensive casting, but it is the biggest factor in reducing operating costs.

The author recently was shown a nozzle which has a guaranteed life of 1,500 working hours. It is quite revolutionary in shape, and the holder for it is incorporated with, and is part of, the sandblast hose. The nozzle itself is turned out of mild steel and is lined with a material known as norbide.

### Sandblast Helmets

It is a considered personal opinion that sandblast helmet makers in this country are a very long way behind the times. American designers have recently evolved several entirely new types of helmet which incorporate purified washed air, a dustproof vision window, new neck seal, adjustable sweat-band and feather balance weight. In most cases, the weight of the helmet is taken by the shoulders and does not touch the head. Every exposed part of these helmets, with the exception of the screen vision protector, is made of pure para or masticated rubber, which, of course, offers the longest life and greatest resistance to abrasion. Further, should the necessity arise, such helmets can be repaired as easily as the inner tube of the ordinary motor-car tyre.

The vision window is about 6 ft. wide and may be either 3, 4, 5 or 6 in. deep. It is so designed that a constantly-blowing jet of air keeps the glass shield clear and clean from dust and, further, a generous supply system provides the operator with a continuous stream of cool, deodorised, washed air, the pressure of the flow of which is easily and quickly regulated to satisfy his own personal breathing requirements.

### Metallic or Non-Metallic Abrasives?

The question of metallic *versus* non-metallic abrasives, as applied in the vitreous-enamelling trade, is a vexed one. In an article in the FOUNDRY TRADE JOURNAL of August 9 last, headed "Silicosis and Sandblasting," it was stated that the total number of deaths in this country from silicosis and silicosis with tuberculosis amongst sandblasters which had come to the notice of the Chief Inspector of Factories and Workshops for the year 1933 was 38, out of a total number of 618 persons engaged in sand and shot blasting.

It will be easily understood, therefore, that the regulations of the Home Office regarding the use of non-metallic abrasives for sandblasting are not too stringent. Further, of the 618 workers above mentioned, 264 only were exposed to sand and, therefore, subject to a risk of contracting silicosis.

In a Paper by Mr. Coupe on "Costing for Vitreous Enamelling," reference is made to the fact that when flint grit is used entirely it has a greater searching effect upon the skin on the castings, and the enamel appears to "flow" more easily than on a surface blasted with steel angular grit only. This is probably due to the fact that the flint grit breaks up on impact, and, as time goes on, a fine silica dust is formed which settles upon or is blown on to the surface treated and acts as a flux.

When de-enamelling sheet-iron or sheet-steel plates, flint grit is also found to be more efficient, owing to the fact that it is 2½ times lighter than an equal quantity of steel abrasive. In consequence, it does not buckle or warp the plates.

Mr. B. B. Kent, in a Paper read to a joint meeting of the London and East Midland Sections of the Institute of British Foundrymen, on November 21, 1934, claimed that perfect results could be obtained by the use of angular steel grit in the sandblast plant of any modern enamelling works, and, with the exception of the de-enamelling of sheet iron, the author was inclined to agree with him entirely.

Metallic abrasives, although higher in first costs, are proving, in practice, more economical, as their life is many times that of sand or flint, and the absence of dust due to no perceptible disintegration produces ideal working conditions for sandblast operation, with correspondingly increased output. Non-metallic abrasives have cleavage. They are composed of many minute crystals held together by a common bond. Impact will disintegrate these crystals, and such disintegration goes on until all cleavage lines disappear and the abrasive is reduced to a useless non-abrasive. In the interim production is hampered and costs are increased by production of dust. Metallic abrasives differ from all other natural abrasives, in that each grain is a solid homogeneous mass and devoid of cleavage lines. On impact, metallic abrasives do not break up; they wear away.

Like air pressures, no one grade of abrasive has been found best adapted to all classes of work. Such a grade should be selected with reference to methods of reclaiming and by working tests on individual requirements to secure the greatest capacity and economy. Metallic abrasives have, by test, shown as high as sixty times the life of sand, but in the cleaning of castings for vitreous enamelling, it may safely be said that one ton of the correct grade of steel grit will outlast 16 tons of any other material.

Large storage bins are unnecessary with metallic abrasives, and large tonnages can be stored in a very small space, by stacking the bags one on top of the other, to any desired height.

Finally, it cannot be too strongly emphasised that, by the installation and use of an abrasive cleaner and separator, a number of the disadvantages encountered by the use of metallic abrasives can be permanently overcome. To anyone who is considering the advisability of changing over from non-metallic to metallic abrasives for cleaning their work, prior to enamelling, it should be pointed out that a sandblast operator who is conversant with the use of flint grit cannot be expected to get first-class results immediately when a change-over is made. He has to become acclimatised to the new conditions.

# High-Duty Cast Iron in the Foundry*

By George Hall

[ABSTRACT]

Much has been published in the technical Press concerning high-duty cast iron—the various uses to which it can be put, the hundreds of compositions and analyses of the various mixtures. Much time and study by metallurgists has brought cast iron to something undreamt of a few years ago.

To produce any high-duty cast iron, it is impossible to repeat the process day after day, unless the foundryman and metallurgist agree to an exchange of opinions and sometimes experiment with certain ideas that each or both may have in his or their mind.

The author was associated for some years with the production of "Lanz Patented Process of Perlit Cast Iron." When this iron was first introduced into this country, very strong exception was taken to its production, by foundrymen and a few metallurgists. Much of the feeling among the foundrymen was because they were of the opinion that it would mean an upheaval of all the foundry plant, and add more trouble to those already existing in the foundry. What is true is that "Perlit Iron" or any other high-duty cast iron cannot be produced without some sort of law and order. It cannot be produced in a foundry, which is in the habit of just pouring some cast iron of questionable quality, into a mould made of uncertain quality sand, and hope for the best, trusting to luck that the casting be a good one.

When a foundry decides to launch out to produce something superior to ordinary iron castings, such as parts for chemical plants, Diesel engines, refrigerators of the $CO_2$ process, and castings which have to stand very high temperatures, such as castings for annealing ovens and rotary retorts for annealing small steel and bronze parts, it may also be called upon to produce high-duty cast irons which can be very high in silicon, for making various castings; as high as 15 to 20 per cent. is often used. Iron, carrying silicon in such large quantities, is bound to give the foundryman trouble, when producing his moulds in the ordinary way. He must, therefore, change his method of moulding if he wishes to secure a good sound casting. Whether the mould be made in loam or sand, whether green or dry, preparations must be made to release the castings as soon as possible after the metal is really set. The reason for this is that the high-silicon content makes the casting weak and liable to fracture whilst contracting.

### High-Silicon Irons

It is always advisable, when building a core for a chemical pan or vessel, to build the brickwork with a greater allowance than is usual in loam moulding. Sufficient space should be left between the bricks and the strickle board for a coil of straw band, such as one would use on a core barrel for a round core, before strickling on the loam; this method obviously allows the collapse of the straw band as soon as the metal burns it; the casting is then automatically released from pressure. All sand used should be of such a nature that it can be easily dug out from corners of brackets, from outlet and inlet branches that are often seen on chemical vessels. If this be not done, or not done well, one will often find the castings in two or three pieces when one arrives at the foundry the following morning. Some two years before the "war," the author was employed for a short time in a foundry where this class of cast iron was being developed, and it was really sad to see the moulders in the morning looking at their efforts of the day previous, often seeing many more bad castings than good ones. The difficulties were gradually overcome, and not so much by altering the mixture of metal, as the methods adopted for producing the moulds. In 1925, when visiting a foundry in Germany, where this composition of metal, with 18 per cent. silicon, was used regularly, the author was agreeably surprised to find, that with special care in producing the moulds, very little trouble was experienced.

### Nickel Iron

There are many irons to-day that are really alloys of cast iron; most of them yield to the good foundry practice which is generally used in a good-class foundry. In one of them, namely, "nickel cast iron," very wonderful castings can be produced, and the process is largely dependent on the "cupola control." Nickel can be added to the molten iron in the ladle, but the best practice is to use a funnel over the cupola spout, and so let the small nickel shot slowly trickle through on to the flowing metal, thereby mixing, and melting, on its way to the ladle. A great deal of care and precaution must be brought into practice when using nickel iron; all runners, risers and scrap must be kept on a separate scrap heap, for the two following reasons: one is, that one cannot produce satisfactory results if runners, risers and scrap are mixed indiscriminately with other irons. A second is, that nickel is costly, and its loss will make castings very expensive if the scrap is not kept separate, carefully analysed, and a true record kept. By including nickel in cast iron there is no doubt that a casting, free from porosity, can be produced with more reliability generally than that produced from good grey iron. If any foundrymen should have occasion to use nickel in their cast-iron mixture, they are recommended to apply to the "Bureau of Information on Nickel," the Mond Nickel Company, Limited, Thames House, Millbank, London, S.W.1, who will provide detailed information.

### "Perlit" Iron

There is very little matter in the various journals and books of the engineering trade concerning "Perlit" iron, and this is not an alloyed iron, but the fact remains, it is still being produced and used in this country successfully, in large quantities. It is not proposed to enter into the controversy, such as that carried on in the technical Press and elsewhere during the years 1925-26. Most founders have probably studied the work of Donaldson, Young, McRea-Smith, and many other eminent metallurgists, when they dealt with the scientific side of the "Lanz Perlit Process." Therefore it is proposed to give personal experiences as one of the few practical foundrymen, who had the responsibility of producing "Lanz Perlit Iron," under the patented process, and not producing something that would be passed off as "Perlit."

If, as has been asserted, some firms, which were licensees, produced something that was not "Perlit," the reason is the firm must have been at fault in the way the process was put into practice. The average moulder, working in the foundry, does not care a "rap" what composition of iron is poured into his mould, but what he is concerned about is whether the casting is free from scabs, and has a clean surface, due only to his personal workmanship. Consequently, one must start the practical production of "Perlit" by interesting, and then educating, the moulder in the new methods, which are different from normal foundry practice. In the first place, careful consideration must be given to the mixing of the sand, of which the moulds are to be made.

### Sand for "Perlit" Iron

The sand for "Perlit" castings must be more refractory than that used for ordinary grey iron in general jobbing work. The mould has to withstand a high temperature in the stove; and, moreover, "Perlit" iron must be poured at a very high temperature if success is to be attained. For the moulding sand, for castings from 3 to 10 cwts. each, and sections of metal of $\frac{3}{4}$ in. up to say $1\frac{1}{2}$ in., one must procure a good sand such as Erith loam, Yorkshire or Ormskirk sand; all of these three sands are much alike in bond and general analysis, and properly used as a facing sand, one can guarantee a good skin on the casting, no matter what temperature is used. Personal experience has brought the author into contact with all kinds of fancy mixtures of facing sand, both on the Continent and at home. Many licensees used coke dust; some used retort carbon mixed with the new sand and the floor sand, largely as a refractory and partly to make the sand more permeable. Having made trials with some of these mixtures and not being satisfied with the results, the conclusion was reached that the best facing sand for "Perlit" iron was a good mixture such as one would use for heavy dry-sand moulds with the addition of mineral carbon, no coal dust or plumbago in this facing sand being necessary. The moulds should be washed with a mixture of mineral carbon and plumbago, mixed with a little clay wash or "Dextrine." A point that must be remembered is that the blacking should be mixed, and allowed to stand for at least 48 hrs. being using; this has the effect of "weathering"; in practice it has the effect of making the blacking smoother when applied to the mould. This will ensure the blue skin on the casting, in spite of the high temperature of the metal when poured into the mould.

### Stoving

The general run of moulds should be placed in the stove, for one night; in the case of large moulds, two nights, at a good temperature, say 350 deg. C. Having dried the moulds, the cores can be placed in position, and the moulds closed; the moulding boxes can then be bolted together, runners and risers placed in position when possible, and the moulds returned to the stove, for their final temperature before casting. It is advisable to have a pyrometer attached to the stove, to register the temperature, and enable the regulation, with exactitude, of the heat, which may be within the region of 400 to 500 deg. C., from 3 to 4 hours' duration, according to requirements. When the moulders are interested there is no difficulty in handling the moulds, at this rather high temperature, when they are taken from the stoves ready for casting. It was often said that it would be difficult to get the moulder to handle the moulds, but no trouble was personally experienced at this particular stage of production. A $\frac{1}{2}$-in. hole should be made in the top of the mould for inserting a thermometer.

### Cupola and Metal Mixtures

Both these must be definitely controlled. No special gadgets are necessary, such as specially-shaped tuyeres, or any definite height from base of cupola to the wind-belt, or height to charging door. Thus any ordinary good cupola, with a glass "water gauge," with a recording of 14 to 15 in. measurement, will be satisfactory. If the iron and coke charges are properly regulated, molten iron can be discharged at the spout, at 1,450 to 1,500 deg. C., and this with the addition of very little more coke than is used for ordinary grey iron. It is essential that the metal be transported quickly from the cupola to the moulds; for being a low carbon-silicon iron, it quickly loses its fluidity, and once

* A Paper read before the West Yorkshire Branch of the Institute of British Foundrymen, Mr. A. W. Walker presiding.

the temperature drops to that of ordinary grey iron it is no longer "Perlit." In the early stages of the production of "Perlit iron" it is advisable to have a good pyrometer to test the temperature of the metal as it leaves the spout of the cupola, and again when pouring the mould. The "Cambridge" disappearing filament pyrometer was found to be as useful and handy as any encountered; these pyrometers are practical, convenient, and accurate instruments, which can be successfully used by unskilled workmen.

#### Stripping the Moulds

Having made the cast, under no circumstances should the moulds be knocked out until the following morning, except in the case of large castings, which, of course, must be left longer, which means to say all castings must be nearly cold before being stripped from the moulds. Otherwise chilled edges may be found on the castings, which will give trouble in the machine shop, and perhaps make scrap of what should have been good "Perlit" iron castings.

#### Runners and Risers

Runners can be much the same as in ordinary grey-iron practice, but in most instances smaller risers may be used, and, most certainly, heads on liners and cylinders, and the like, can be reduced by one-half the size and weight that are used in general practice. In fact, in Germany "Perlit" cylinders, liners, etc., are seen cast without heads, but with an additional machining allowance on the top side of the casting. This method was personally adopted in many cases, and it proved successful. At the same time it is not advisable to cast without heads in a general way.

"Lanz Perlit" iron is not the "bogey" in the foundry that so many foundrymen and others connected with the trade have thought it to be. This is also confirmed by A. E. McRea Smith, M.A., B.Sc., in his article on "Properties of 'Perlit' Iron," printed in the FOUNDRY TRADE JOURNAL of July 1, 1926.

In conclusion, it is asserted that the demand for good sound castings to-day, with small machining allowances, fine finish and a good skin, almost places products from the ordinary grey-iron foundry in the class of high-duty iron. If the mixtures, cupola and sand are controlled with the co-operation of a good metallurgist, whether he be either inside or outside of the works, there is no reason whatever why one should not produce good castings, free from porosity and of a good tensile strength. The author's works regularly produce ordinary grey iron, from 14 to 16 tons tensile, and this is produced from the pig-irons used in every-day practice.

## Catalogue Received

**Foundry Sand.** To the best of our knowledge, the first catalogue to be published on the subject of foundry sands is that just received from the Abbey Sand Company, Limited, of 29, Strand, Barrow-in-Furness, and, indeed, it sets a high standard. It gives a typical composition and photomicrographs of the grades as resolved by sieving. Illustrations are given of iron, steel and non-ferrous castings made in Abbey sand moulds, and a page is devoted to Absabond—a plastic colloidal clay. We would have liked to see included the physical properties of the four grades marketed. However, as the catalogue is of the loose-leaf variety, such material can easily be added should industry be insistent in its demands for such additional information. The question of transport, which is such a vital factor in the choice of sand in the various districts, is very intelligently tackled.

## Institute of British Foundrymen

### ELECTION OF NEW MEMBERS

At a General Council Meeting, held at the Great Northern and Victoria Hotel, Bradford, on Saturday, January 12, 1935, the following were elected to various grades of membership.

No less than ninety-three applications were dealt with at the meeting.

*As Subscribing Firm.*

Brown & Sons (Huddersfield), Limited, Park Works, Huddersfield (represented by David Brown), gearing specialists.

*As Members.*

Baker, E.A., general manager, Haywood Foundries, Limited, London, N.W.; Cameron, A. R., coke and pig-iron salesman, W. Baird & Company; Davis, H. L. N., B.A., student, Diamond Foundry, Luton; Durrans, J., foundry blacking manufacturer, Pennine Works, Hazlehead; Forrester, John, senr., assistant works manager, Mitchell, Russell & Company, Bonnybridge; Gaussen, F. M., steel foundry superintendent, Vickers Commonwealth Steel Products, Limited; Henderson, J. A., salesman (coke and pig-iron), W. Baird & Company; Rennie, J. A., dealer in steel-foundry refractories, Reid & Rennie, Glasgow; Visick, F., partner, W. Visick & Sons, Basset Works, Devoran.

Arbuthnot, A., foundry superintendent, Ford Motor Company, Dagenham; Fletcher, B. S., foundry proprietor, Fletcher, Houston & Company, Limited, Wolverhampton; Jackson, E., master brass moulder, E. Jackson & Company, Lord Street, Manchester; Bradley, H., works manager, Crumblehulme, Limited, Bolton; Causebrook, R., foundry requisite salesman, T. W. Ward, Limited; Gardner, A., works manager, Metters, Limited, Melbourne; Henbrey, H. J., foundryman; Pipes, R., technical representative, J. North, Limited, Isleworth; Russell, J., pig-iron salesman, Shotts Iron Company; Scott, R., managing director, Atlas Steel Foundry; Spanner, M. F., B.Sc., chemist, Beeston Boiler Company, Limited; Taylor, W., foundry manager, Suffolk Iron Foundry, Limited; Thomas, H. S., director, c/o Thomas Bros., Agents, Limited, E.C.; Geisler, W. A., foundry manager, A. Teves, Masch. & Armaturen Fabr. G.m.b.H.; Smart, G., agent.

*As Associate Members.*

Adderley, J., foundry foreman, R. Hall & Son, Limited, Bury; Allan, J., mechanical engineer, Mitchell, Russell & Company, Bonnybridge; Arnott, J. G., foundryman, Clyde Alloy Steel Company; Beattie, J. P., works progress clerk, Mitchell, Russell & Company; Benwell, J., chief order clerk, Mitchell, Russell & Company, Limited; Briggs, J. H., iron patternmaker, Howard & Bullough; Buckley, H., patternmaker, T. Ashworth, Rosegrove; Campbell, W., foundry foreman, H. Hollingdrake & Sons, Limited; Chesters, W. T., apprentice metallurgist, Keighley Laboratories, Limited; Crabtree, J. E., foreman moulder, Howard & Bullough, Limited; Foley, T., assistant foundry metallurgist, Ford Motor Company, Dagenham; Goodwin, A. G., draughtsman, Mitchell, Russell & Company, Limited; Gorst, H., foreman moulder, Whitehead & Poole; Hargreaves, A. M., ironfounding coremaker, T. Ashworth & Company, Rosegrove; Hargreaves, J. R., journeyman moulder, Howard & Bullough; Healy, M., assistant foundry superintendent, Ford Motor Company, Dagenham; Johnston, A. M., foreman patternmaker, Mitchell, Russell & Company, Limited; Loudon, A., draughtsman, Smith & Wellstood, Limited; Miller, J., foreman ironmoulder, Glenfield & Kennedy, Limited; Moodie, T., patternmaker, Grahamston Iron Company, Limited; McMurray, G., foreman moulder, J. Lang & Sons, Johnstone; Mactaggart, W. T., cost clerk, Mitchell, Russell, Limited; McWatt, J. H., patternmaker, Mitchell, Russell, Limited; Snelling, A. E., fitter (experimental), Smith & Wellstood, Limited; Stainton, R. W., foreman ironmoulder, Gilbert, Gilkes & Gordon, Limited; Stephenson, G. M., ironfounder (experimental), Smith & Wellstood, Limited; Wale, H., iron patternmaker, Howard & Bullough, Limited; Walker, D., junr., patternmaker, Mitchell, Russell & Company; Walton, E., foundry foreman, Crossley Bros., Openshaw.

Cunningham, E., patternmaker, Grangemouth Iron Company; Graham, J. A., works manager, Hampson & Southwick, Limited; Matthews, F., master patternmaker, Reliance Pattern Making Company; Millar, H. M., iron moulder, Fullwood Foundry Company, Limited; Shaw, R. R., patternmaker, Summerford Iron Company, Falkirk; Smith, A. J. N., B.Sc., metallurgist, B.C.I.R.A., Birmingham; Barkhouse, S., foundry enameller, Lane & Girvan, Limited, Bonnybridge; Berridge, D. W., foundry chemist, S. Russell & Sons; Garside, J. E., research scholar, College of Technology, Manchester; Gill, W., moulder, Premier Gas Engine Company; Haighton, J. K., salesman, R. Haighton, Limited, Nelson; Holland, E., metal patternmaker, Leys Malleable Castings Company, Limited; Innes, R. A., moulder, Blairs, Limited; Jowett, R., foreman moulder, C.W.S. Iron Works, Keighley; Judd, J. A., metallurgist, British Piston Ring Company, Limited; Marsh, R., assistant chemist, Ford Motor Company; Morris, R. L., foundry foreman, Morris & Company, Bradley, Bilston; Niven, W., foundry foreman, Premier Gas Engine Company, Limited; Oddy, J., charge of foundry machine repair (patternmaker by trade), Ford Motor Company); Rodgers, R., supervisor, machine moulding, Leys Malleable Castings Company; Simmonds, W., iron moulder, Benley & Jackson, Bury; Smith, A., foundry foreman, Crumblehulme, Limited, Bolton; Swift, J. C., foreman patternmaker, Renold & Coventry Chain Company; Swindell, F. J., foreman pulverised-fuel plant, Leys Malleable Castings Company; Tunley, A. C., foundry floor staff, Austin Motor Company; Wilson, A. J., assistant foreman, Brass Foundry, Woolwich Arsenal.

Blackwell, I., production engineer, Davis Gas Stove Company, Limited, Luton.

*As Associates.*

Aitken, W. M., ironmoulder, Babcock & Wilcox, Limited, Renfrew; Rulton, F. F., apprentice moulder, L.N.E.R. Works, Stratford; Simpson, B., journeyman moulder, Platt Bros., Oldham; Weare, A. T., assistant metallurgist, British Piston Ring Company; Burrell, J. analytical chemist, North Eastern Marine Engineering Company; Fenwick, W., moulder, R. & A. Mains, Edmonton; Forrester, jun., W. J., electrical engineer, Mitchell Russell & Company; Howe, R. D., patternmaker, Guest & Chrimes; Liddell, jun., A., electrical engineer, Mitchell & Russell & Company; Potts, J. W., moulder, Metropolitan-Vickers, Limited; Swann, A., moulder.

PLANS ARE BEING COMPLETED for the establishment at an early date of a cutlery factory at Newbridge, County Kildare. Messrs. Thomas Ashe & Sons, a Sheffield firm, which has complied with the provisions of the Free State Control of Manufactures Act, are behind the project, and the necessary permit to enable the new company which has been formed to proceed has been granted by the Free State Minister of Industry and Commerce. The action of the Minister in favouring Newbridge has raised a storm of protest in Tralee, County Kerry, where Messrs. Gladwin, another Sheffield firm, were interested in a similar project. It is understood, when operations have advanced sufficiently, the Free State Government will take action to control the importation of cutlery into the country.

# Defects in Iron Castings: Their Cause and Cure*

By T. Tyrie

In taking up the subject of defective castings, it is done so in the full knowledge that considerable difference of opinion exists amongst foundrymen and metallurgists regarding the nature and cause of many of the troubles which arise in the production of iron castings. Since uniformity of opinion is a very desirable factor in the drive towards eliminating these bogeys, it is thought wise to present the results of

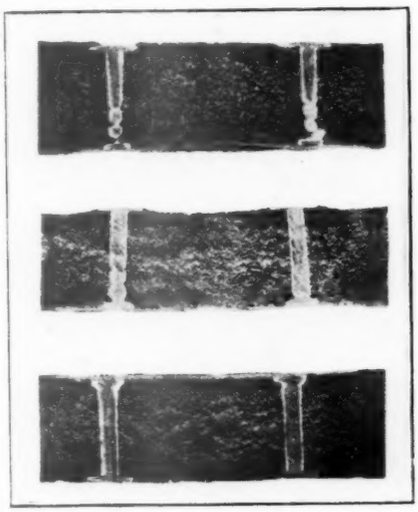

FIG. 1.—SULPHUR PRINTS, SHOWING CHAPLETS IN SECTION BLOCKS.

recent critical examinations of several types of defects, in the hope that they may lead to a better understanding of the nature and cause of such defects, and, having established these, the elimination becomes only a matter of time.

It is to be clearly understood that the scope of the present Paper is confined more or less to small- and medium-weight general engineering castings, such as are produced on a repetition basis, but with few exceptions the general finding can be applied to heavy work.

Defects may arise primarily from one or more of four possible sources:—Metal, sand, moulding practice and design. Extended they include:—

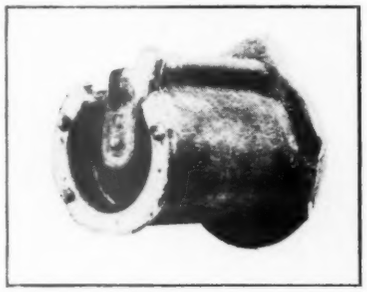

FIG. 2.—BLOW-HOLE IN METER CYLINDER CAUSED BY POOR-QUALITY WAX VENT.

(1) Faulty composition and melting of the metal; a lack of fluidity due to composition, temperature, gas inclusion; incorrect casting temperature. All these are a function of the metal.

(2) The sand used for the mould or core may be of unsuitable composition; insufficiently permeable to gases; lacking in strength; insufficiently refractory; or too rigid to yield to the contraction of the metal whilst cooling. All these are a function of the sand.

(3) More often the defects are due to small errors in the patterns, such as faulty jointing, giving rise to wrong positions for runners and risers, or cores may be so placed that proper venting is hard to obtain. The actual size, shape and position of runners and risers may be faulty and productive of mould erosion, gas trapping, metal dulling, and the consequent improper running and cold shuts. Risers may be too small and so far removed from heavy sections that feeding is impossible. Tackle may be in bad repair, especially moulding-box bushes and pins, giving rise to sided castings and cross-joints; moulds may be closed end for end; moulds may be crushed or knocked against whilst sitting ready to cast, giving rise to sand holes and dirty castings. All these are a function of moulding practice and care in the foundry.

(4) Design of casting may be such as to disregard totally the fundamental principles of the moulder's art and the metal in use, in which case the production of sound castings is attended with the greatest difficulty. This is a function of the designer or engineer, and is beyond the scope of the present Paper.

For convenience of treatment, it has been decided to classify the defects met with in foundry practice in accordance with the scheme in use in the author's employ, as follow:—(1) Mould and core faults, embracing crushing, scabbing, cores breaking and run-outs; (2) sided and cross-joints, embracing cores lifting, faulty closing, worn tackle, etc.; (3) blow holes; (4) sand holes; (5) slag holes; (6) metal faults, embracing drawn and porous castings, contraction cracks, cold shuts, gas holes and oxidised metal; and (7) bad work, embracing closing of moulds wrongly, short pours, interrupted pours, etc.

It will not be possible in the space available to consider each type in detail, nor, indeed, is such necessary, since some defects are so readily recognised and the cause and cure so obvious to the intelligent foundryman that no useful purpose is to be served by going into detail here. Rather will it be the objective to scan but lightly these obvious defects and direct attention to a more full consideration of a few particular types which, upon the surface, often appear so simple yet are so hard to overcome because their real nature has not been recognised.

### Mould and Core Faults

*Crushing* is more common in dry sand than in green sand, since the latter is more plastic and will yield to any misfit in the mould or core parts. A clearance should be pared off the joints of all moulds, and, when dealing with deep patterns, care should be exercised to trim back the joints which tend to become pulled up slightly when withdrawing the pattern.

*Scabbing* in a green-sand mould may arise from sand being too wet, mould rammed too hard or insufficient venting. Particular care should be exercised not to ram projecting parts of a mould too hard, and the point of the rammer should not be allowed to come closer to the pattern than from 1¼ to 1½ in., since otherwise the result will almost inevitably be a series of small scabs. The vent wire should also be used freely on projecting parts of the mould. Scabbing can also be caused by excessive use of the "swab" for pattern drawing, and it is advisable to prevent this practice as much as possible. In dry-sand work, scabs are almost always due to improper venting, and it is advisable to use sand with good venting properties, or, alternatively, a sand which evolves little gas on casting.

### Cores Breaking

*Cores breaking* are more often the fault of the coremaker than the moulder. Cores should be properly strengthened with irons wherever necessary, and it must be realised that good cores cannot be made from sand, which in itself is of poor quality. Another core fault which has been observed arises directly from the use of oil sand. This is a tendency for oil-sand cores to soften and yield to the pressure of the molten metal whilst casting, if such cores have been allowed to sit in a green-sand mould for extended periods, such as over the week-end. The remedy for this is, of course, perfectly obvious.

FIG. 3.—INCLUSIONS IN TOP SURFACE BLOW-HOLE.

*Run-outs* arise through the pressure of the molten metal lifting the cope, and the remedy lies in increasing the weights holding the top part down or altering the method of securing it. Many run-outs occur without any lifting of the cope, but by the metal creeping along joints and ultimately pouring out at the box joints. The precautions required to overcome this trouble are everyday practice, and a waster on this account is perfectly avoidable in the majority of cases.

### Sided and Cross Joints

*Sided* castings are the direct results of two faults: (*a*) Cores lifting and (*b*) faulty positioning of cores in the mould, whereby the divisioning of the metal section is rendered uneven.

The former fault, *i.e.*, cores lifting, is more often a complaint against the patternmaker than

FIG. 4.—ANOTHER EXAMPLE OF A SURFACE BLOW-HOLE.

the moulder, on account of insufficient prints on the patterns. This is false economy, as the few pence saved in the pattern shop are wiped out by the additional work for the moulder, with the risk of a bad casting.

Chaplets are often of great service in preventing cores from lifting, but the proper use of these should be well known if porosity is to be avoided. It is surprising how many moulders are under the impression that chaplets actually

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* Paper read before the Scottish Branch of the Institute of British Foundrymen. Mr. H. Hurst presiding.

melt and become diffused throughout the mass of metal poured into the mould. It is not necessary nor, indeed desirable that the chaplet should melt completely, since its doing so would undo the purpose for which it has been used. Nevertheless, it is an advantage to have incipient fusion to ensure complete welding of the chaplet and the base metal. The secret of this is, of course, absolute cleanliness and freedom from oxidation, under which conditions

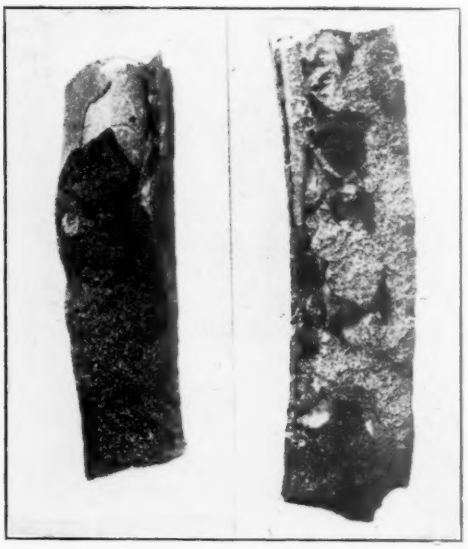

FIG. 5.—NAIL-SHAPED INCLUSION IN TOP LEFT-HAND CORNER OF RIGHT SECTION.

there should be no trouble from porosity or blowing. Fig. 1 shows the sulphur prints obtained from sectioning three blocks having chaplets cast-in, in such a manner as to section the chaplets. In one case the chaplet was cleaned from rust, etc., by pickling in acid and thoroughly washing and drying. In another, the chaplet used was coated with red lead, and in the third case a tinned chaplet was employed. It was found that best results were obtained from the pickled chaplet, whilst the tinned one was next and the red-lead-coated one last. There is, however, little to choose between the pickled chaplet and the tinned one, and in view of the expense involved in pickling, along with the trouble of storing in a dry place to ensure that the cleaned goods will not rust up again, the tinned chaplet is, on the whole, the more profitable.

The latter fault, *i.e.*, faulty positioning of cores, is inexcusable except in the heaviest and most intricate of work, where the positioning of cores at times assumes a difficult aspect. The usual method of gauging metal sections around cores by means of clay stamps is universally practised and for intricate work in many places cores are now being set to specially-designed gauges.

It should also be added in this connection that under certain conditions where oil sand is being used there is a tendency for cores to sag slightly whilst sitting in the green state prior to baking, and unless the finished cores are carefully gauged before being issued to the moulder some trouble is likely to arise under this heading.

*Cross joints* are generally the result of slackness in moulding box pins and holes. The fault is inexcusable, but may be attributed to both moulder and master. In general work where moulding boxes are not jig-drilled and bushed a certain amount of clearance in the pin holes is necessary. The common practice for ensuring correct registering of cope and drag are sufficiently serviceable if properly applied. On the other hand, if the management will provide well-made boxes for use in the foundry the possibility of risks being taken is removed and this class of trouble eliminated to a large extent. Especially is this necessary in plate- and machine-moulding practice where wear on the box pins and pin-holes should be checked occasionally, as also the tolerance allowed in moulding machine pins and pattern-plate holes.

### Blow-holes

Blow-holes have usually a smooth, shiny and bluish surface, and to a large extent are caused by gas coming from cores which are not thoroughly dried or are not properly vented. Occasionally blowing occurs even when such precautions have been observed, and in such cases the trouble may be due to metal getting into the core vent and causing a choke, very often resulting in the metal blowing violently out of the runner and riser. Fig. 2 illustrates a meter cylinder which shows a blow-hole on the top. In this case the trouble has arisen through the use of core-vent wax of inferior quality and which did not permit of a clear vent being obtained after baking, in the jacketed core which forms the by-pass waterway seen on the side of the casting. Another source of blow-holes has been brought to light as a result of careful investigations of this prevalent trouble, and it is proposed to treat the subject in rather a fuller manner. The defect comprises blow-holes surrounding metallic inclusions in the form of pellets, and it is contended the trouble arises out of faulty pouring in conjunction with metal on the dull side. In Figs. 3 and 4 it will be seen that metallic inclusions are embedded in a blow-hole just on the top surface of the casting, whilst Fig. 5 shows an interesting inclusion in the shape of a nail which may be seen on the top left-hand corner of the section. Fig. 6 shows a sectional view of an inclusion and Fig. 7 is a reproduction of sulphur prints from the section of Fig. 6 and a similar sound section below the defect in the same casting. It is to be clearly understood that the inclusions here considered always appear near the surface of a casting and are not to be confused with the segregation globules occasionally observed in gas pockets in the interior and final sections of a casting to solidify.

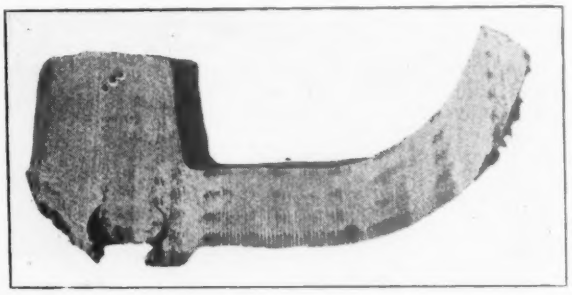

FIG. 6.—SECTIONAL VIEW OF AN INCLUSION.

Close examination of the sulphur prints reveals an outstanding difference in the appearance of the metal which forms the pellet compared with that of the main body of the casting. A small amount of slag may be seen in the vicinity of the pellet, and the general appearance of both sulphur prints leads to the conclusion that the metal temperature was not quite so high as it might have been, although there is no reason to believe that it was too cold.

Micro-sections were next cut from each specimen in such a way as to include an inclusion along with the base metal, and these were examined in the polished condition at 100 dias. Fig. 8 shows the section illustrated in Fig. 5,

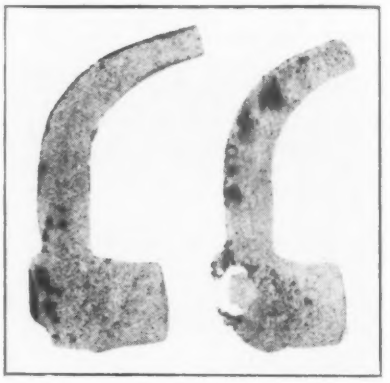

FIG. 7.—SULPHUR PRINT OF THE INCLUSIONS SHOWN IN FIG. 6.

in which was seen the nail-like inclusion. The section is very interesting, as no bond is apparent between the inclusion and the main body of metal. Furthermore, a disturbance has occurred in the neighbourhood of the inclusion which has resulted in a separation of the main body of metal itself, as evidenced in the right-hand portion of the illustration. That this is a division of the main metal and not another inclusion is clearly evident from the similarity in the metal, whereas the difference between the inclusion and the main body is very marked. The inclusion shows small curly graphite, suggesting rapid cooling with formation of a chilled iron which has subsequently undergone slight annealing whilst slowly cooled in proximity with the body of metal around it, whereas the base metal, by virtue of its relative bulk, has undergone relatively slow cooling and exhibits the usual graphite-flake formation. A consideration of the conditions shown in Fig. 5 and the present one leads to the assumption that the inclusion is the result of a dribble of metal getting down the pouring gate and solidifying prior to casting proper taking place.

Fig. 9 shows a section through the bead inclusion previously shown in Fig. 5. Here again a distinct line of demarcation exists between the inclusion and the base metal, but in this instance there has been no great disturbance in the mould as a result of the inclusion. The dividing line is scarcely visible, and but for the discontinuity of the graphite formations and the difference in form in the two sections, the inclusion might almost be considered as welded on to the base metal. These divergencies, however, amply justify the assumption that the pellet was in existence as such prior to being surrounded by molten iron, and the fact that no blowing has resulted is due to the condition of the skin of the inclusion. More will be said on that point later.

Fig. 10 is taken from another valve, and has been chosen to show the co-existence of two sets of conditions. On the left-hand side can be seen a line of demarcation between the inclusion which forms the upper part of the picture and the lower part formed by the base metal. But as the eye travels from left to right the line gets more obscure, until finally it disappears

in a complete rosette of graphite. The curly graphite of the inclusion and the plate graphite of the base metal still show the difference in the condition of the metals, but at their junction a tendency towards fusion is evident, and has, in fact, actually occurred in the neighbourhood of the rosette-like graphite patch. It may be added that examination of the section along the line of division, but extending farther to the right, condrawn from Fig. 1, of a third set of conditions, namely, a complete welding of the bead inclusion and the base metal. The left-hand side of the picture shows the bead inclusion, whilst the right-hand side shows the base metal. In the middle is clearly seen a band of graphite flakes common to both sections and formed by the fusion of the bead and consequent diffusion of the two metals.

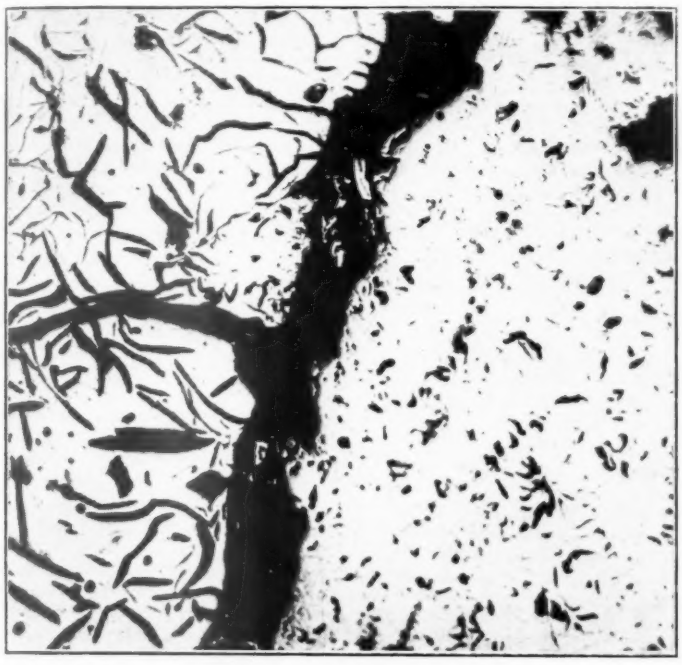

FIG. 8.—MICROSECTION OF THE NAIL-LIKE INCLUSION SHOWN IN FIG. 5. × 100.

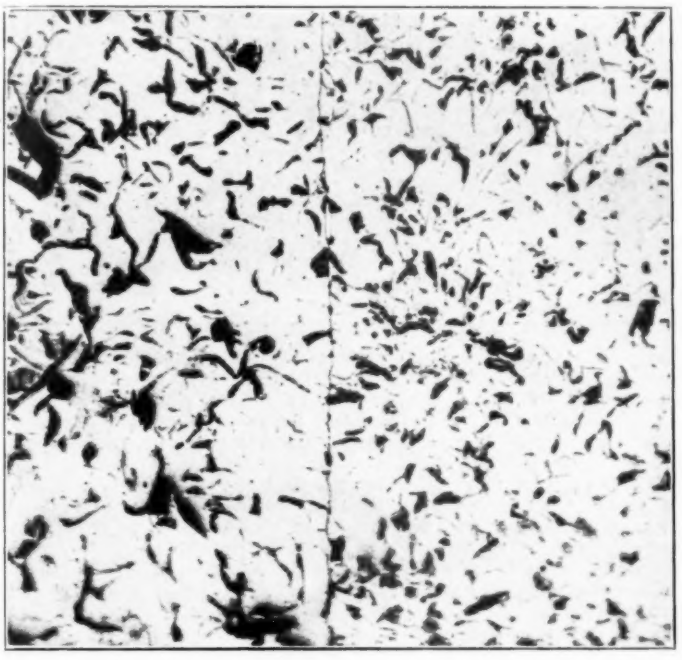

FIG. 9.—MICROSECTION OF THE BEAD INCLUSION SHOWN IN FIG. 5. × 100.

FIG. 10.—MICROSECTION OF A VALVE SHOWING CO-EXISTENCE OF TWO SETS OF CONDITIONS. × 100.

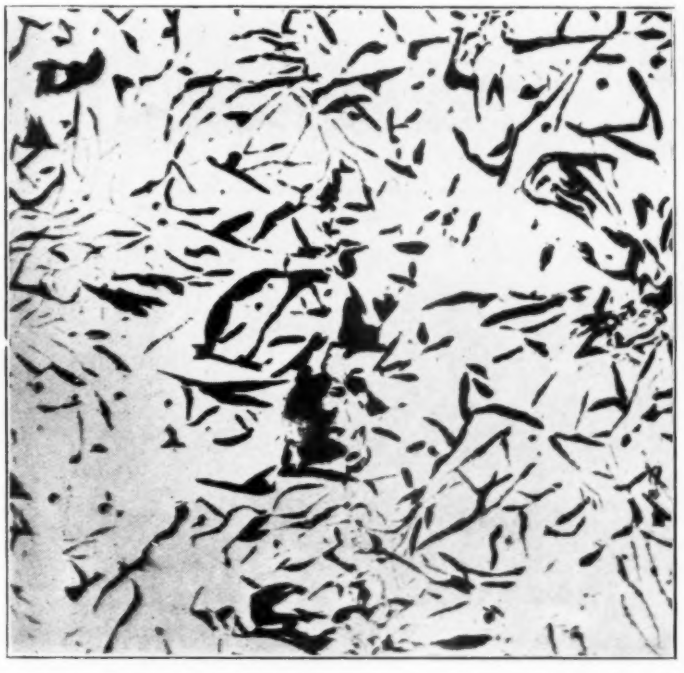

FIG. 11.—MICROSECTION OF FIG. 1, SHOWING COMPLETE WELDING OF BEAD INCLUSION AND BASE METAL.

firms this, as no difference in structure is ultimately visible.

The above has illustrated two sets of conditions, namely, an inclusion with no bond whatever between itself and the main body of the casting, and an inclusion which is partly welded to the base metal. Fig. 11 provides an example,

**Interim Summaries**

The inclusions in every case have a different structure from the base metal, as evidenced by the micro-sections and sulphur prints; they may or may not give rise to disturbances in the mould, and they may or may not be partially or totally fused to the base metal. It would appear that these inclusions are present prior to pouring, and are a result of faulty pouring, a slight spill in the pouring basin giving rise to the formation of pellets in the mould or, as appears the case in one of the illustrations, a leaky plug, permitting a thin stream of metal to flow past, creating a dribble. Once formed, the subsequent behaviour of these inclusions depends upon circumstances. If the surface of the inclusion is perfectly free from oxide and slag and the metal normally hot, in all probability the inclusion will weld on to the base metal with no ill-effects. If, on the other hand, the surface is oxidised or coated with slag, no welding is possible, and a disturbance originating at the inclusion and causing a blow-hole is inevitable. It should be

mentioned that a careful examination for entrapped slag throughout the entire section in every case considered revealed no trace whatever, except in the vicinity of blow-holes containing a pellet, a fact which is not surprising, since a spill of metal is almost certain to carry a little slag or oxide with it, and this falls into the mould, adhering to the metal.

It is well enough known that dull metal will give rise to many defects, among which may be included blow-holes, and it may be contended the present examples arise from that source. To pursue this point, an attempt was made to produce the defect intentionally. Accordingly, a valve was cast at a temperature of 1,080 deg. C., which is much below normal pouring temperature, and was, in fact, so low that the metal did not fully come up the risers. In spite of this, the valve, upon examination, was found to be perfectly sound. Continuing this, another cast was made, but just prior to pouring a spill was caused, resulting in a little metal entering the mould. The metal temperature in this case was normal practice, around 1,300 deg. C., and upon examining the casting again, no trace of the pellets was to be found. This shows that a slight spill in itself will not give rise to the defect, provided metal of normal casting temperature follows and no slag or oxide is present. A third attempt was more successful, and was conducted as above, except that dull metal was used to follow the spill. In this case definite inclusions and blow-holes were produced, as illustrated in Fig. 12, the valve body being badly blown at several places.

FIG. 12.—INTENTIONAL INCLUSIONS AND BLOW-HOLES PRODUCED IN A VALVE BODY CASTING.

It seems apparent, then, that this type of defect arises out of splashing and pouring with metal which is on the dull side, combined with the presence of slag or oxide, and a survey of many castings defective due to blow-holes reveals the fact that the majority of them fall under this category rather than under the class of blow-holes due to dampness or venting deficiencies. Care in pouring and good hot metal will eliminate the trouble entirely.

Fig. 13 shows a hydrant cover exhibiting the defect just considered. It was assumed at first that the blow-hole in this case had arisen through a disturbance originating at the surface of the iron chill used to overcome porosity in the heavy section of metal. An examination of the casting, however, revealed the case as identical with those just described, and no useful purpose is to be gained by pursuing the example further. It is possible that blow-holes may arise from faulty chills, but no direct case has come to personal notice.

### Sand Holes

This is a very prevalent defect in most foundries, especially where repetition work is practised, and may arise from one or more of many causes, for example:—

(1) Loose sand in the mould itself; adhering to cores or in runner or pouring basin.

(2) Sand washed away or into mould from angles such as edge of down-runner at pouring basin or mould, or from mould corners through edges being weak. Excessive use of the swab for drawing patterns or gate pattern aggravates this.

(3) Entry of dust or sand into mould after it has been closed. This may be caused by carelessness, the mould being knocked or sand dropped into runners from boots when stepping over moulds. Or it may arise from crushes at partings and at core prints or from sand dropped from top parts.

(4) Friability of mould surface due to sand drying out.

(5) Slight scabbing from the mould or core due to improper gating or improper mould manufacture.

(6) Wash of mould facing into pockets due to lack of adhesion between mould facing and sand.

(7) Wash of blacking from cores.

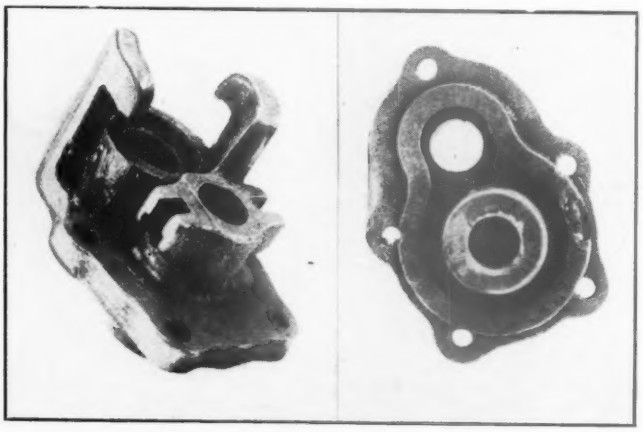

FIG. 13.—FAULTY HYDRANT CASTING.

(8) Soft ramming around the base of runner or riser.

(9) Wash from imperfectly baked cores or too much gas evolved causing metal disturbance.

(10) Explosion of gas causing sand to drop.

(11) Improper sand. Low permeability and high strength, or sand too weak. Insufficient strength after drying. Insufficient or too much moisture.

(12) Vibration communicated by conveyors.

*(To be concluded.)*

## United States Steel Industry

### HIGH WAGES AND SMALL RETURN ON CAPITAL

The American Iron and Steel Institute, in their publication, "Steel Facts," No. 2, give some interesting facts relating to the condition of the United States steel industry during the current year. A table shows that in September last there were 381,828 employees in the industry, compared with 417,020 a year ago, that the pay roll was $29,142,892, compared with $37,322,250; that the average hours worked per week were 24.2, compared with 32.8; and that the average earnings per hour was 73.8 c., compared with 63.6 c. in September, 1933. In October the percentage of capacity employed was 24.59, compared with 36.89 per cent. in October, 1933.

The statement goes on to point out that an average loss of $6.10 on each ton of steel ingots made in the third quarter was incurred by the steel industry; in the second quarter there was an average profit of $2.65 per ton produced. The estimate is based on financial reports made public by 17 companies representing approximately 85 per cent. of the steel-ingot-producing capacity of the country, indicating a total deficit for the entire industry during the third quarter of $25,000,000.

In the second quarter of the year, it is estimated that the industry had a profit of $24,600,000. For the first nine months the indicated deficit was $8,300,000. The second quarter's earnings were exceeded by losses in the third quarter due to a sharp drop in demand beginning in July. Second-quarter mill operations averaged 53.90 per cent. of capacity, compared with 24.14 per cent. in the third quarter, a decline of 55 per cent.

Complete reports to the American Iron and Steel Institute from companies with over 99 per cent. of the country's steel capacity for the first half of 1934 show a return on investment during the period of only 0.86 per cent. This was entirely wiped out by the third-quarter results, when the industry's combined deficit was greater than its combined profit in the first half.

The total investment in the industry at the close of 1933 was $4,848,010,935 and net income for the first six months of this year, after deducting interest, depletion and depreciation, was $23,954,857. Dividends paid amounted to $8,841,617, while pay rolls totalled $321,586,940. The rate of operations over the first half averaged 47.1 per cent. The sharp decline in operations in the industry has come from the tremendous slump in demand from the so-called durable-goods industries: building construction, railroad equipment and similar heavy industries. These are activities involving long-term commitments which will only be made when confidence in the future is re-established. A "price war" in the steel industry would not restore such confidence, nor do anything but retard progress.

Pay rolls of the steel industry take 41 cents out of every dollar received from gross sales, and are the largest single expense item in steel-mill operation. This was revealed by an analysis made of the major expenses from 1924 through 1933 of steel companies representing 75 per cent. of the steelmaking capacity of the country. Only 6½ cents of the gross sales dollar during the 10-year period were paid to stockholders as dividends, and only 1 cent was added to surplus. A charge of 6 cents from each sales dollar was made for depreciation and obsolescence of equipment and facilities. Tax payments of all kinds took an average of 4½ cents a year during the past ten years. One cent was paid out in interest charges. The 40 cents remaining from the gross sales dollar after these items had been paid were spent for raw materials and for all the other expenses.

# Permanent Set and Elastic Hysteresis in Cast Iron

By J. E. Hurst, Vice-President, Institute of British Foundrymen

(*Concluded from page* 406, *vol.* 51.)

The same test-rings were subjected to a second gradual application of stress over the same range after a lapse of 72½ hrs. (4 p.m., 15/8/32). In the case of each of these specimens the magnitude of the permanent set expressed in inches increment of gap was of a very small order up to a stress value of 7 tons per sq. in. approximately (a load of 8 lbs.). The maximum increment in gap was of the order of 0.004 in., amounting to less than 1 per cent. of the total increment in gap at the stress value mentioned above. On reaching a load of 10 lbs. (8.9 tons per sq. in.) in the specimens 5A and 5C, and 12 lbs. (10.7 tons per sq. in.) in the specimen 5B, the gap after removal of the load collapsed to a value of actually slightly lower than that of the original free gap at the commencement of the test. Each of the specimens was reloaded twice in succession to the same stress value and a stable gap after reloading was obtained, in the case of specimen (5A) less than the initial free gap by an amount of 0.004 in. and in the case of specimens 5B and 5C greater than the initial free gap by an amount of 0.004 in. and 0.002 in. respectively. Further continued loading up to the stress value of 17.85 tons per sq. in. as in the first loading was accompanied by permanent set which increased steadily with the increment in stress. The final magnitude of the permanent set was considerably less than that obtained on first loading and is indicated diagrammatically in the graph, Fig. 5.

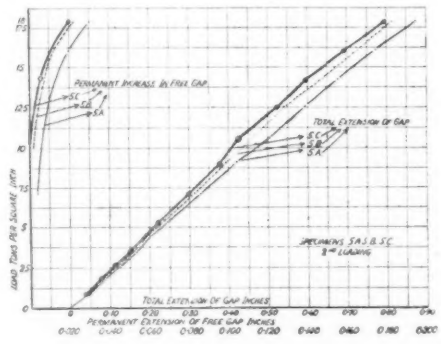
PERMANENT INCREASE IN FREE GAP
TOTAL EXTENSION OF GAP
SPECIMENS 5A,5B,5C
TOTAL EXTENSION OF GAP INCHES
PERMANENT EXTENSION OF FREE GAP INCHES

FIG. 5.

The final gap measurements after the experience of these second loadings as outlined were checked after standing for intervals of 18½ and 44 hrs. with the results shown in Table IX.

TABLE IX.

| Specimen. | Stress. Tons per sq. in. | Final gap after 72 hrs., 1st stress. Ins. | Final gap after 2nd stress. Ins. | Gap after standing 18½ hrs. Ins. | Change. Ins. | Gap after standing 44 hrs. Ins. | Change. Ins. |
|---|---|---|---|---|---|---|---|
| 5A .. .. | 17.85 | 0.608 | 0.638 | 0.630 | — 0.008 | 0.630 | Nil |
| 5B .. .. | 17.7 | 0.600 | 0.632 | 0.626 | — 0.006 | 0.626 | Nil |
| 5C .. .. | 17.85 | 0.564 | 0.584 | 0.578 | — 0.006 | 0.578 | Nil |

The permanent increment of the final gap over that obtained in the first stress is smaller than that experienced in the first test as already indicated. The change in gap after standing is in the direction opposite to that of the applied stresses and of a similar magnitude to that obtained during the first stressing of the same specimens. The whole of this change or hysteresis has taken place apparently in a standing period of 18½ hrs., for no further change is recorded after the longer standing period of 44 hrs. The specimen 5B shows a slightly less change of gap after standing than in the case of the previous stressing.

The same test-rings 5A, 5B and 5C were subjected to a third further gradual application of stress over the same range followed by a fourth similar application with an interval of 24 hrs. during which the change or hysteresis in the free gap was measured. The permanent-gap extension with increasing stress was still less in each case than previously, and in the third loading slight trace of the "collapse" occurrence was recorded in specimens 5A and 5B only at stress values of 5 lbs. (4.45 tons per sq. in.) and 8 lbs. (7.15 tons per sq. in.) respectively. This occurrence was completely absent during the fourth series of loadings. After the fourth series of loadings the permanent-set values were nil up to certain stress values and the final values for the stress of 17.85 tons per sq. in. were of a small order of magnitude, as indicated in Table X.

TABLE X.—*Showing Small Order of Permanent Increment in Gap.*

| Load. Lbs. | 5A. Permanent increment in gap. Ins. | 5A. P/set. Per cent. | 5B. Permanent increment in gap. Ins. | 5B. P/set. Per cent. | 5C. Permanent increment in gap. Ins. | 5C. P/set. Per cent. |
|---|---|---|---|---|---|---|
| 1 .. .. | 0.000 | Nil | 0.000 | Nil | 0.000 | Nil |
| 2 .. .. | 0.000 | ,, | 0.000 | ,, | 0.000 | ,, |
| 3 .. .. | 0.000 | ,, | 0.000 | ,, | 0.000 | ,, |
| 4 .. .. | 0.000 | ,, | 0.000 | ,, | 0.000 | ,, |
| 5 .. .. | 0.000 | ,, | 0.000 | ,, | 0.000 | ,, |
| 6 .. .. | 0.002 | 0.885 | 0.000 | ,, | 0.000 | ,, |
| 8 .. .. | 0.002 | 0.65 | 0.002 | 0.67 | 0.000 | ,, |
| 10 .. .. | 0.004 | 1.53 | 0.002 | 0.54 | 0.000 | ,, |
| 12 .. .. | 0.004 | 0.85 | 0.002 | 0.44 | 0.000 | ,, |
| 14 .. .. | 0.004 | 0.74 | 0.004 | 0.76 | 0.002 | 0.33 |
| 16 .. .. | 0.006 | 0.97 | 0.004 | 0.66 | 0.002 | 0.30 |
| 18 .. .. | 0.008 | 1.13 | 0.006 | 0.88 | 0.004 | 0.53 |

TABLE XI.—*Results Obtained from Repeated Squeezings.*

| Specimen. | Original free gap. Ins. | Stable free gap after stressing four times opening. Ins. | Increment in gap due to opening stress. Ins. | Gap after squeezing to closure. Ins. Once. | Twice. | 10th. | Load to close. Lbs. 1st. | 2nd. | 10th. |
|---|---|---|---|---|---|---|---|---|---|
| 5A .. | 0.374 | 0.644 | 0.270 | 0.476 | 0.466 | 0.456 | 12.8 | 12.85 | 12.65 |
| 5B .. | 0.374 | 0.640 | 0.266 | 0.474 | 0.466 | 0.450 | 13.7 | 13.45 | 13.35 |
| 5C .. | 0.406 | 0.580 | 0.174 | 0.488 | 0.484 | 0.476 | 13.5 | 13.40 | 13.25 |

The results of the measurements of the free gaps after standing, after the third and fourth stressing operations, showed a slight change, less than in the previous tests, and still negative in character. After the fourth stressing, the changes in gaps for the specimens 5A, 5B and 5C were respectively 0.004-, 0.002- and 0.002-in. gap closure, considerably less in magnitude than the results obtained from the previous stressing.

It is clear that the repeated application of load to these test-rings has brought about a condition in which the repeated application of stress is accompanied by a very small amount of permanent set. The total permanent set obtained during these four operations is, of course, quite a substantial amount, and a comparison can be made from the figures given in the columns (2) and (3) of Table XI. With the test-rings in this condition, it was decided to ascertain the effect of the application of stress in the opposite direction, that is, by squeezing to closure of the gap following the practice established in the determination of the EN value. The results, after repeated squeezing ten times, are given in the Table No. XI, and show at once that this stressing in the opposite direction is accompanied by considerable permanent deformation of the gap. The final gaps after the tenth squeeze were examined after an interval of two hours, and after a further squeezing when the rings were held squeezed for a complete period of two hours. A slight change in gap was found after standing two hours after the tenth squeeze in specimens 5A and 5C, whilst specimen 5B (the "as-cast" specimen) showed no change.

The changes in gap after the tenth squeeze in specimens 5A and 5C were respectively — 0.004 and — 0.002 in. The movement in gap is negative, exactly opposite in direction to that obtained after squeezing in a previous experiment (Rings No. 6), recorded above, and exactly opposite in relation to the applied stress to that expected.

Immediately after the eleventh squeeze, during which the load was maintained for two hours, the gaps showed no change from the stable gap attained after the tenth squeeze. After an interval of four days, the gaps were again re-measured and found to have undergone a movement; this time positive in direction (*i.e.*, opening and opposite in direction to that of the applied stress). The positive gap recovery was the same in each of the three specimens, *viz.*, 0.004 in.

### Reappearance of Permanent Set

The rings having attained a stable gap after squeezing were again restressed by gap opening-up to a stress value of 17.86 tons per sq. in. This constitutes the fifth cycle of tensile stressing applied to these specimens. The results obtained are illustrated in the diagram, Fig. 6, which includes the curves of permanent increment of free gap in inches and tool-gap extension under load. On the same diagram the magnitude of the permanent set of the free gap after the third and fourth loadings is indicated also. Whilst in magnitude the permanent set is substantially less than in the original unstressed material, it is quite clearly demonstrated

that permanent-set reappears as a result of stressing in the opposite direction specimens which have previously sustained repetitions of stress until a condition of no permanent set has been attained.

Three further test-rings from the same material, No. 4A, 4B and 4C, were used to determine the extent of the repetitions of gradual loading necessary in these materials to bring about the condition of no permanent set. The test-rings were loaded to a stress value of 14 tons per sq. in., and care was taken to ensure that the rings were not squeezed or stressed in any way prior to the loading experiments after cutting the gaps. The gaps were cut in a restrained manner in order to measure the gap movement due to internal stress. These values are recorded for the three specimens in Table XII.

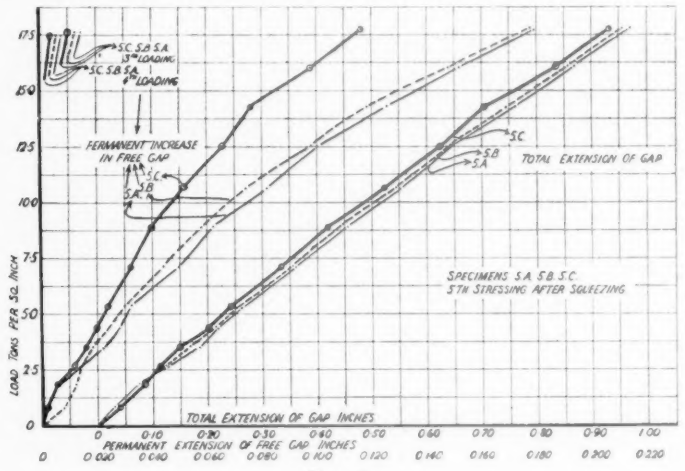
S.C. S.B. S.A. 3RD LOADING
S.C. S.B. S.A. 4TH LOADING
PERMANENT INCREASE IN FREE GAP
S.C
S.B
S.A
TOTAL EXTENSION OF GAP
SPECIMENS S.A. S.B. S.C. 5TH STRESSING AFTER SQUEEZING
LOAD TONS PER SQ. INCH
TOTAL EXTENSION OF GAP INCHES
PERMANENT EXTENSION OF FREE GAP INCHES

FIG. 6.

TABLE XII.—*Gap Movements due to Internal Stress.*

| Specimen. | Dia. uncut. Ins. | *b.* Ins. | *t.* Ins. | Gap cut. Ins. | Free gap. Ins. | Gap movement. |
|---|---|---|---|---|---|---|
| 4A .. .. | 4.53 | 0.250 | 0.143 | 0.428 | 0.430 | + 0.002 |
| 4B .. .. | 4.53 | 0.250 | 0.143 | 0.428 | 0.430 | + 0.002 |
| 4C .. .. | 4.53 | 0.247 | 0.142 | 0.428 | 0.432 | + 0.004 |

The evidence of internal stress, it will be noticed, is again different in magnitude from that of the previous specimens tested of the same material. In the case of the annealed sand-cast material, specimen 4A freedom from permanent set under the conditions of the experiment was obtained after the fourth loading. The second and third loadings showed no permanent set over the greater part of the stress range. Exactly the same remarks apply to the specimen of this material in the "as-cast" condition, and there is very little difference between the magnitudes of the permanent set recorded for both these specimens. The actual extension of the gap at the maximum load is greater in the annealed than in the "as-cast" specimen, and the permanent increase in gap is also slightly greater. In the case of the centrifugally cast specimen, complete freedom from permanent set was obtained after the third loading, and almost complete freedom from permanent set was obtained during the second loading, permanent set making its appearance in this case during the last addition of load to 14 tons per sq. in.

These tests were carried out over the two days September 5 and 6, 1932, and, after completion, the test-rings free from permanent set were allowed to stand for approximately fifteen days until September 20, 1932. The gaps were then remeasured and the test-rings submitted to further gradual loading in the same manner over the stress range. On remeasurement of the gaps, movements are recorded in Table XIII.

The gap movement or hysteresis has taken place similar in character to that noticed in the previous experiments recorded, and in the same cast material of an order of magnitude not greatly different. In the case of the centrifugally-cast specimen, the gap movement has reached a very high value of 0.022 in.

The specimens were subjected to restressing after this period of 15 days. In the case of the annealed sand-cast specimen, the first restressing was accompanied by the appearance of permanent set which was again completely removed on stressing a second time. The same remarks apply to the "as-cast" specimen except that the permanent set did not commence until a load value of 8 lbs. was reached on first restressing. In the centrifugally-cast specimen quite a substantial amount of permanent set reappeared on first restressing, and this was completely absent on restressing a second time. Thus after allowing the specimens to rest for a period the gap recovery takes place, and they again become susceptible to permanent set, which can be removed easily by a single second stressing.

TABLE XIII.—*Gap Movements after Prolonged Standing.*

| Specimen. | Gap after stressing. Ins. | Gap after standing 15 days. Ins. | Change in gap. Ins. |
|---|---|---|---|
| 4A .. .. | 0.632 | 0.624 | − 0.008 |
| 4B .. .. | 0.606 | 0.600 | − 0.006 |
| 4C .. .. | 0.526 | 0.504 | − 0.022 |

After all the above treatments the test-rings were subjected to squeezing as for the determination of the EN value, immediately upon completion of the final stressing by gap opening. Again the results show that squeezing is accompanied by permanent deformation of the gap, which in the case of the annealed sand-cast specimen reaches a stable value after the fourth squeeze, and in the case of the "as-cast" sand-cast specimen after the second squeeze. In the case of the centrifugally-cast material the stable gap is attained after the third squeeze. These gaps, after squeezing, were re-examined after a period of rest of 20 days. The gap movement recorded was a decrease of 0.002, 0.004 and 0.006 in. respectively in each of the specimens, and this negative recovery is similar to that experienced in the previous experiment on squeezing immediately after gradual stressing by gap opening.

In these experiments there are a number of features which it is possible to review, and it is proposed to do this at this stage in the order of: (*a*) internal stress; (*b*) permanent-set characteristics, and (*c*) hysteresis due to strains.

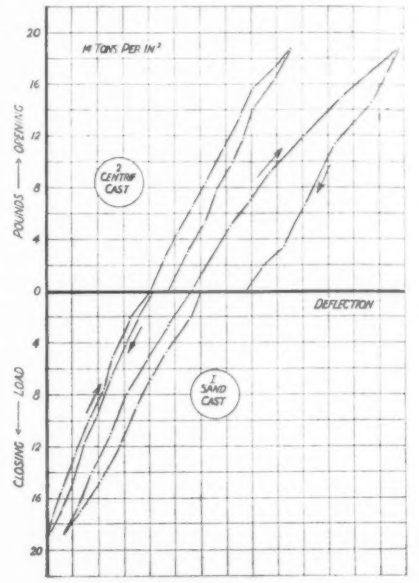


FIG. 7.

**Internal Stress**

The movement recorded in the gaps cut in the test-rings is regarded as evidence of the existence of internal stress. All the test-rings show evidence of this internal stress, and although in the case of each material all the rings were derived from the same casting, the internal stress varies greatly in individual rings. The sand-cast material in two sets of rings showed internal stress of opposite characteristics to the centrifugal-cast material, but in the third set, Nos. 4(A) and 4(B), they showed the same directional character as the centrifugal-cast specimen No. 4(C). It is clear that the stabilising treatment has not removed the internal stress in every case, and in specimens 5A and 5B the stabilised specimens show the greater internal stress. There is no clear connection between the magnitude of the internal stress (gap movement) and the permanent-set or hysteresis characteristics.

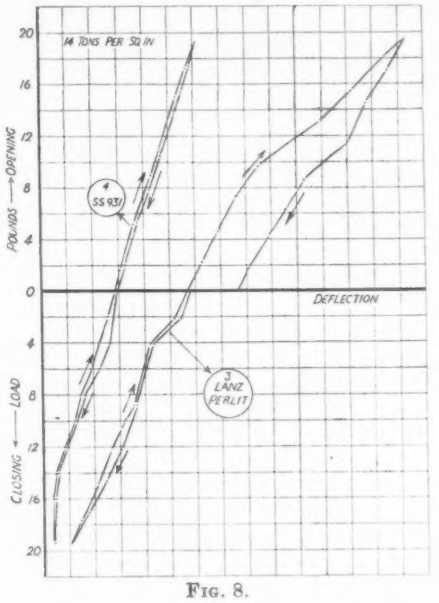


FIG. 8.

(*Concluded on page 66.*)

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## Permanent Set and Elastic Hysteresis in Cast Iron

(*Concluded from page* 64.)

### Permanent Set

All the experiments show that the magnitude of the permanent set obtained on first stressing is greater in the sand-cast than in the centrifugally-cast specimens under all conditions of stressing (*i.e.*, squeezing to closure or opening). The stabilising or annealing treatment has had the effect of increasing the magnitude of the permanent set and the maximum total deformation (gap opening) under load is obtained in the stabilised specimens. The centrifugal specimens show the least total deformation under load, particularly in the higher-stress ranges.

Repeated loading to the same stress value is accompanied by a reduction in the magnitude of the permanent set in all the specimens and after repeated loading the relative order of the permanent set in each of the types of materials remains the same under conditions of loading to a constant stress value of 14 tons per sq. in. Under the conditions of these experiments and within the limits of accuracy of the methods of measurement used, three repetitions of loading are necessary to remove the permanent set in each of the sand-cast specimens and two repetitions in the case of the centrifugally-cast material. It has been suggested (*e.g.*, Morley Strength of Materials) that the reduction in permanent set experienced on reloading might be due to the dissipation of internal casting stresses. There is no clear evidence of this revealed by these experiments.

The magnitude of the total permanent set sustained by the specimens after repeated stressing to a condition of no permanent set is greater in the sand-cast than in the centrifugal specimens. The condition of no permanent set obtained by repeated stressing is immediately altered by the application of stress to the specimens in the opposite direction, and closure of the rings by squeezing resulted in the recovery of a good deal of the permanent set. Under all conditions the centrifugally-cast material showed lower permanent-set values than the sand-cast specimens, and broadly, the effect of the stabilising treatment applied to this particular material has been to increase the magnitude of the permanent set.

### Hysteresis due to Strain

The experiments clearly demonstrate that the gap dimensions in the test-rings which have been subjected to stressing by opening or closing undergo a change with time after the removal of the applied stress, and a final stable gap measurement is obtained only after several hours have elapsed after the removal of the stress. This is the phenomenon referred to as "hysteresis" due to strain, and it is apparent from the experiments that it occurs even after the application of quite low stresses applied in the closure of the test-rings. The continued movement of the gap dimensions with time appears to take place in a direction opposite to that of the applied stress. If the rings have been subjected to a stress bringing about closure, then, after the removal of the stress, the gap tends to continue opening and *vice versa*. There does not appear to be any relation between the occurrence of this phenomenon and the magnitude of the internal stresses as revealed by the extent of the movement of the free gaps on slitting. Hysteresis of this type persists after the repeated application of stress, but appears to diminish somewhat in magnitude. A curious influence of repeated stressing on the direction of the hysteresis movement is revealed by the experiments on rings 5A, 5B and 5C. On reversing the applied stress after five repetitions of stress in one direction, the hysteresis movement observed after the reversal of the stress continued in the direction established by the initial stresses. A second prolonged application of stress in the reversed direction was necessary before the hysteresis took place in the direction observed in the previous experiments, *i.e.*, opposite to the direction of the applied stress. It would appear that continued stressing in one direction gives a predominant directional effect to the hysteresis which requires more than a single reversal of stress to remove it. This is shown in the tests made with specimens Nos. 4A, 4B and 4C, where, after five reversals of the stress and standing for 20 days, the direction of the hysteresis still remained in the direction of the reversed stress. The magnitude of the hysteresis was greater in the sand castings than in the centrifugal casting, and greater in the stabilised than in the "as-cast" specimen.

### Elastic Hysteresis

The following investigations were undertaken to explore the character of the elastic hysteresis, and for this purpose ring-form specimens similar in character were used. The method of testing, utilising such specimens, lends itself admirably to experiments of this character. A complete cycle of stress was applied to the rings, which were cut with a gap large enough to sustain a predetermined stress during the closing of the gap to a predetermined small amount. Starting with closing the test-rings, stress was applied gradually, and the reduction in gap was measured with increasing stress. When the predetermined maximum stress was attained, the load was gradually removed, and the gap dimensions measured with the gradual decrement in load. The same specimen was then subject to a load (tensile load) applied to open the gap, and the same procedure followed. The curves plotted showing the relation between gap opening and the cycle of applied stress yield a characteristic hysteresis loop, as shown in the diagram. For the purpose of these initial experiments, a series of different material were chosen. Details of these are given in Table XIV.

The castings used for the preparation of the test-rings were all the same nominal size as far as diameter and radial thickness were concerned. The sample No. 3 Lanz perlit was of German origin and supplied by a friend in Germany. Some of the principal mechanical properties of these specimens are summarised in Table XV.

The cycle of stress adopted in the tests was over a range of a maximum of 14 tons per sq. in. calculated in accordance with the method laid down in B.S.I. Specification No. 5004. The hysteresis diagrams obtained are illustrated in Figs. 7 and 8. The marked difference in behaviour of the four different materials tested is indicated clearly in the diagrams. In the case of the SS 931 material only is a closed loop obtained over the cycle of stress adopted and with this material the extent of the hysteresis is of a very small order over the whole stress range. The specimen of Lanz Perlit behaves very differently and shows a considerable amount of permanent set after the operation, the hysteresis being of a very large order during the opening portion of the cycle. The same remarks apply to the specimen of sand-cast material No. 1, and this closely resembles in behaviour the Lanz Perlit specimen. The centrifugally-cast specimen, whilst not yielding a closed loop, more closely resembles the SS 931 material. The importance of the behaviour of cast iron under cyclic conditions of stress of this character is very great, and the properties of cast iron in this respect will well repay more extended study.

TABLE XIV.—*Chemical Composition of Materials Used.*

| No. | Material. | T.C. | C.C. | Gr. | Si. | Mn. | P. | Ni. | Cr. | Al. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sand cast .. .. | 3.29 | 0.79 | 2.50 | 1.51 | 0.89 | 0.48 | Nil | Nil | Nil |
| 2 | Centrifugal cast .. | 3.40 | 0.65 | 2.75 | 2.09 | 0.80 | 0.71 | Nil | 0.27 | Nil |
| 3 | Lanz Perlit .. | | | | No analysis available. | | | | | |
| 4 | SS 931 .. .. | 2.62 | — | — | 2.55 | 0.42 | 0.08 | Nil | 1.48 | 1.60 |

TABLE XV.—*Mechanical Properties of Various Irons.*

| No. | Material. | EN value. Lbs. per sq. in. | Permanent set. Per cent. | Tensile strength. Tons per sq. in. | Brinell no. |
|---|---|---|---|---|---|
| 1 | Sand cast .. .. | 11.4 | 23.0 | 17.4 | 218 |
| 2 | Centrifugal cast .. | 16.7 | 12.8 | 18.1 | 257 |
| 3 | Lanz Perlit .. | 17.2 | 25.8 | 18.8 | 241 |
| 4 | SS. 931 .. .. | 23.3 | 2.2 | 31.6 | 302 |

## Activities of the English Electric Company in 1934

In the course of a review of their activities during the past year, the English Electric Company, Limited, state that the general improvement in industry as a whole has been reflected in very satisfactory increases in transformer business in this country. They have supplied the Central Electricity Board with 10,000-k.v.a. 33-kv. transformers to replace existing units at Worthing, and new 20,000-k.v.a. 33-kv. units to replace those installed some time ago at Bury, Lancs. Industrial activity has also resulted in several instances of bulk supply being given to large manufacturers. An interesting example of this is the supply given by Sheffield Corporation to the works of Messrs. Thomas Firth & John Brown, where the company supplied two 20,000-k.v.a. transformers to step-up the supply at Blackburn Meadows to 33 kv. for transmission to the Atlas Works. Many transformers of various capacities were built for supply undertakings.

The heavy electrical engineering departments have been very active; it is, however, only possible to mention a few of the more interesting plants manufactured during the year, including an order for three turbo-alternator sets, comprising a 15,000-kw., 5,000-kw. and 750-kw. set; an order from Sheffield Corporation for a 30,000-kw. turbo-alternator and other units. In rolling-mill drives the large reversing-mill equipment for the South African Iron & Steel Industrial Corporation has been set to work very successfully since the beginning of the year, while an order has been obtained recently for a very important blooming-mill drive for the British (Guest Keen Baldwins) Iron & Steel Company, Limited, Cardiff, which will embody one of the largest and quickest operating equipments in the country. Further reversing-mill equipments of smaller capacities are in course of manufacture for other important customers in the United Kingdom. On non-reversing rolling mills the equipment supplied for the Morgan-Davy rod mill for the Lancashire Steel Corporation was set to work early in the year and has been giving record outputs, while the continuous-bar and rod mill for the South African Steel Corporation has also been put into satisfactory operation. A further driving equipment for a Morgan-Davy continuous-rod mill has been almost completed for Messrs. Guest, Keen & Nettlefolds, Cardiff, while many smaller drives for sheet and merchant mills have been supplied and put into operation. Some large electrical winding equipments have been supplied during the year or are on order.

MICRO—PHOTOGRAPHS
(Magnification. x 8.)
OF
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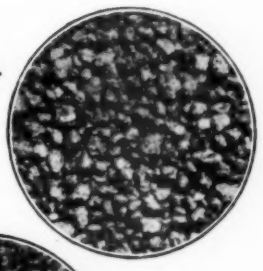
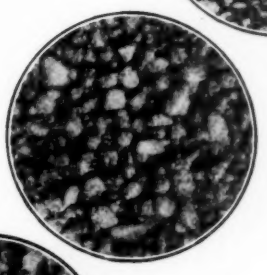
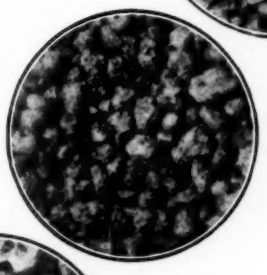
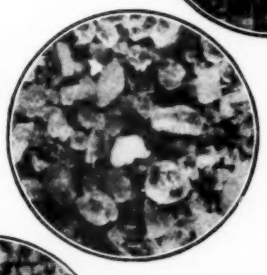
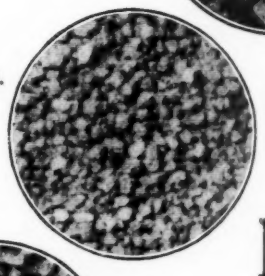
# MOULDING SANDS

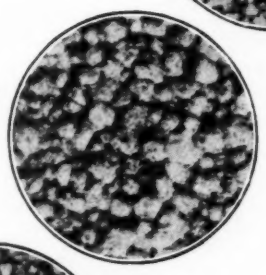

Bramcote Red Superfine Sand.

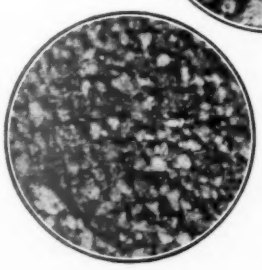

Bramcote Red Medium Sand.


Yorkshire Steel-Moulding Sand.


K.L. Washed Silica Sand.


York Yellow 102 Sand.


Scottish Rock Sand.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# This Week's News in Brief

## Trade Talk

THE FOUNDRY of Messrs. R. Fairlie & Sons, Auchtermuchty, Fife, which closed down recently, has been reopened.

MR. RAMSAY MACDONALD, the Prime Minister, last week paid a visit to the foundry of Messrs. Gillett & Johnstone, Croydon, to view a newly-completed carillon of bells for St. John's Church, Perth.

MESSRS. SWAN, HUNTER & WIGHAM RICHARDSON, LIMITED, have received a contract from Sir Arthur Sutherland for a vessel of 1,000 tons deadweight for the Tyne-Tees Steamship Company. The vessel will be built at the Neptune yard.

MESSRS. NIAGARA SCREENS (GREAT BRITAIN), LIMITED, Enfield, Middlesex, have taken over the entire business of Messrs. J. Darnley Taylor & Company (1931), Limited, manufacturers of "Niagara" counterflow vibratory screens.

THE ENGLISH ELECTRIC COMPANY, LIMITED, have been awarded a contract for the supply and erection of Diesel generating plant, which will provide the complete power requirements for the British Pavilion at the International Exhibition, Brussels.

GENERAL REFRACTORIES, LIMITED, Sheffield, announce that their sales for the month of December (the last month of its financial year) constitute a new record in the history of the company. The total turnover for 1934 is stated to be far in advance of that of the previous year.

A MEETING OF THE 5½ per cent. first mortgage debenture stockholders of Messrs. Hadfields, Limited, was convened for yesterday, to consider proposals to postpone for ten years—to 1957 instead of 1947—the date of the maturity of the stock and to reduce the interest thereon to 4¼ per cent. per annum. The total amount outstanding is £1,039,137.

MESSRS. J. R. TURNER & COMPANY, steel and iron merchants, Glasgow, have purchased the foundry buildings formerly occupied by Dennystown Brass Works, Limited, at Dalreoch, Dumbarton. The buildings and site were bought at the low upset price of £100. It is understood that Messrs. Turner propose using the premises as a metal and machinery store.

MESSRS. THERMOTANK, LIMITED, Govan, Glasgow, have booked a contract for the ventilation equipment of the passenger liners at present being built in Germany for the Norddeutscher Lloyd and the Hamburg-Amerika Line. There are at present five ships under construction. The patent Punkah Louvre equipment, to be supplied by Thermotank, Limited, will be similar to that fitted to the German super liners "Bremen" and "Europa" by the same firm.

THE GRANGEMOUTH DOCKYARD COMPANY, LIMITED, has been successful in negotiating for contracts in connection with the repairing and overhaul of 12 ships, which will ensure full-time working of the yard for some time for almost every trade connected with shipbuilding and ship repairing. The most important of the vessels to be altered is the s.s. "Anna V," which was purchased from Finnish owners by Metal Industries, Limited, to be used in assisting s.s. "Bertha" in the salvage of German vessels in Scapa Flow.

THE AILSA SHIPBUILDING COMPANY, LIMITED, Troon, has secured an order from Messrs. William Robertson, of Glasgow, for a single-screw motor vessel for Continental and home trading services. The vessel will be of the raised quarter-deck type, built under Lloyd's special survey, with hull scantlings in several respects in excess of classification requirements. She will be propelled by Diesel engines fitted aft, and having sufficient power for a service speed of 10 knots. Auxiliary machinery on deck and in the engine room will be electrically driven.

ARRANGEMENTS HAVE BEEN MADE by the Iron and Steel Trades Confederation for the transfer of 300 men and their wives and families from Scotland to Corby, where they have been promised work at the new Stewarts and Lloyds plant. Mr. R. Dennison, assistant general secretary of the Confederation, has been at Mossend consulting with the local branch officials, who concur in the plans made by the union. When the firm closed their plant at Clydesdale a year ago, over 600 men were displaced. About 300 of these have been transferred to Corby. A further 300 men will be taken on as the production develops.

THE LONDON & NORTH EASTERN RAILWAY COMPANY state that during 1935 about 5,000 goods wagons and brake vans will be built, including 1,580 wagons of the open 12-ton type and 2,200 of the covered 12-ton type, all fitted with the vacuum brake, and 100 all-steel 20-ton wagons for the conveyance of locomotive coal. The last-named will be of all-welded construction. It has been decided to construct 88 locomotives of types more capable of handling traffic under modern conditions of weight and speed than the engines which are being replaced. The company's programme also includes the renewal of 436 miles of permanent way and 37 bridges.

ACCORDING TO PROVISIONAL OFFICIAL RETURNS, the output of pig-iron in Russia in 1934 totalled 10,500,000 metric tons, as against 7,200,000 and 6,200,000 tons in 1933 and 1932 respectively. Steel production is estimated to total 9,600,000 tons, against 6,900,000 and 5,800,000 tons respectively in 1933 and 1932, while the outputs of rolling-mill products totalled 6,690,000, 4,800,000 and 4,200,000 metric tons respectively. It is pertinent to note that only last year, the second year of the second Five-Year Plan, did the Russian iron and steel industry reach and exceed the projected figures expected under the first Five-Year Plan. The programme for the current year includes 12,500,000 tons of pig-iron, 11,800,000 tons of steel and 8,650,000 tons of rolling-mill products, as well as 27,500,000 tons of iron ore and 16,750,000 tons of coke.

## Contracts Open

**St. Albans,** January 23.—Deep borehole pump, for the St. Albans Sand & Gravel Company, Limited. London Colney, St. Albans, Herts.

**Straits Settlements,** March 4.—Sluice valves, for Singapore Municipal Water Department. The Department of Overseas Trade. (Reference G.Y. 14,653.)

**Askwith,** February 8.—Supply and laying of 4-in. and 3-in. cast-iron pipes, for the Wharfedale Rural District Council. The Council Offices, Otley. (Fee £1 1s., returnable.)

**Swansea,** January 22.—Steam shunting locomotive, for the Town Council. Messrs. Preece, Cardew & Rider, 8, Queen Anne's Gate, Westminster, S.W.1. (Fee £2 2s., returnable.)

**East Grinstead,** January 31.—Electric automatic pumping plant, in duplicate, for the Urban District Council. The Engineer and Surveyor, Council Offices, London Road, East Grinstead.

**Dunkeld,** February 5.—Providing and laying about 14 miles water pipes, 9 in. to 3 in. dia. (mainly 6 in.) and other works, for the Perth County Council. Messrs. H. J. Bell & Company, 18, Charlotte Street, Perth. (Fee £1, returnable.)

**Penycoedcae,** January 24.—Providing and laying 1,380 yds. of 3-in. dia. cast-iron pipe, 1,970 yds. of 3-in. dia. cement-asbestos pressure pipes, pumping installation, 16-ft. by 16-ft. by 8-ft. pressed-steel tank, valves, and other works, for the Urban District Council. Mr. D. J. M. Peregrine, clerk, Council Offices, School Street, Pontyclun, Glam. (Fee £3 3s., returnable.)

## New Companies

*(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)*

**Hill & Son (Manchester), Limited,** 127, Thomas Street, Miles Platting, Manchester.—Capital £3,000. Ironfounders and engineers. Directors: Lizzie Mortlock and L. Mortlock.

**Bell & Harwood, Limited,** 27, Duke Street, Gosta Green, Birmingham, 3.—Capital £1,000. Manufacturers of ferrous and non-ferrous metals. Directors: E. Harwood and G. T. Bell.

**Stamford Engineering Company, Limited,** Minerva Works, Minerva Road, Park Royal, N.W.10.—Capital £5,000. Manufacturers of gas, steam and water-tube fittings. Directors: P. Stevens and Rachel Stevens.

**Putney Castings, Limited,** 207, Putney Bridge Road, Wandsworth, London, S.W.—Capital £2,000. To take over the foundry business carried on by L. T. Dixon at Wandsworth. Directors: L. T. Dixon, R. H. Pavitt and R. L. L. Dixon.

## Personal

MR. B. H. BROWN, manager for the North of England of the Associated British Machine Tool Makers, Limited, has been elected chairman of the North-Eastern Branch of the Institution of Mechanical Engineers.

MR. C. J. DADSWELL, who in 1925 took his B.Sc.(Eng.), London, with first-class honours, and subsequently obtained the degree Ph.D.(Eng.), London, in 1927, has just received the diploma of Ingenieur de l'Ecole Superieure de Fonderie, which has never before been awarded to an Englishman.

MR. WILLIAM TURNER MACLELLAN, C.B.E., J.P., has retired from the board of Messrs. P. & W. MacLellan, Limited, engineers, Glasgow and London. Mr. Grahame H. Thomson has been appointed chairman of the company. Mr. MacLellan has acted as chairman of the company for the past 33 years, and has been connected with the firm during the whole of his business life, which has extended over 56 years. In 1928, on the completion of 50 years' association, Mr. MacLellan's long services were specially recognised by the employees. For services during the war at the Ministry of Munitions, Mr. MacLellan was honoured by the British, French, Belgian and Italian Governments.

MR. JAMES ORR, who had completed 46 years' service with Messrs. Glenfield & Kennedy, Limited, Kilmarnock, retired last December, and on January 8 was entertained by workers of the general engineering department of Glenfield Works and presented with an easy chair, together with two valuable Doulton ware ornaments for Mrs. Orr. Mr. Orr served his apprenticeship with Messrs. Andrew Barclay, Sons & Company, Limited, Kilmarnock, and as a young journeyman transferred to Glenfield & Kennedy, Limited. Mr. Orr eventually took charge of all outside erections for the firm, and made a name for himself by the ingenuity and resourcefulness which he displayed in erections in places where facilities for transport and tackle for handling heavy loads were absent.

### Will

CRUMP, EDWARD BARNETT, of Coseley, works manager of the Cannon Iron Foundries, Limited, Deepfields, Bilston ... ... ... ... ... £2,543

## Obituary

MR. PETER ROBERTS, a well-known gratefitter in the employ of Carron Company, died suddenly on January 8. He was 66 years of age.

MR. RONALD J. H. RITCHIE, director and works manager of Messrs. James & Ronald Ritchie, Limited, Middlesbrough, cast-iron pipe manufacturers, died on Monday. Mr. Ritchie was forty years of age and son of the late Mr. James Ritchie, founder of the firm. He was a member of the Council of the Middlesbrough Branch of the Institute of British Foundrymen, and a member of the Cleveland Institute of Engineers.

MR. JOHN ALEXANDER, director of Messrs. Barclay, Curle & Company, Limited, died at his residence in Scotstounhill, Glasgow, on January 8, after a short illness. Mr. Alexander was at business up to the time of closing down for the New Year holidays, but caught a cold which developed into pneumonia. He had a life-long connection with the firm with the exception of two years spent in Belfast, and he was made a director two or three years ago. He had served in every official position in the engine department, and before being appointed to the board had filled the post of engineering general manager for 12 years. His pioneer work in connection with the production of large Diesel engines for marine propulsion was well known. He was a member of the Institute of Civil Engineers and the Institute of Naval Architects.

## Company Report

**Westinghouse Brake & Saxby Signal Company, Limited.**—Profit for year to September 30 last of £23,615, after providing for depreciation, income-tax, all working expenses and making provision of £22,352 for losses of subsidiary companies; brought in, £2,324; dividend of 2½ per cent., less tax, £21,745; carried forward, £4,193.

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Complete installations.

Continuous Castings Systems.

Sand Mixers.

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HALIFAX, YORKS.

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# Raw Material Markets

The iron and steel markets retain their cheerful tone, as, although new business is still below the usual level, the producing works generally have plenty of work in hand and are confident of being able to maintain activity at the level prevailing in 1934, with a probability of registering a further improvement. There is once again a strong demand for pig-iron, and it is possible that an increase in production may have to be made in the near future.

## Pig-Iron

**MIDDLESBROUGH.**—There is a heavy local demand for Cleveland foundry iron, and, with the Scottish foundries once more taking deliveries, the stocks of iron accumulated at the furnaces during the holiday period are being speedily reduced. No alteration has been made in the scale of minimum prices, and it is believed that none is contemplated. Quoted prices include, of course, all delivery charges, and for No. 3 G.M.B. quality these quotations are 67s. 6d. per ton delivered Middlesbrough, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk, and 70s. 3d. delivered Glasgow. For other qualities there are the usual differences, namely, 2s. 6d. per ton premium for No. 1 quality and 1s. per ton discount for No. 4 foundry and No. 4 forge iron.

The East Coast hematite trade is in a strong position, the full output being sold for two or three months ahead, whilst a number of further inquiries are in circulation. Current business mainly concerns the home market, but it is satisfactory to note that business with overseas customers has lately shown a more active tendency. Export prices are not controlled, and vary considerably, but all home business is regulated by the fixed scale of prices, based on 69s. per ton for No. 1 East Coast hematite delivered Middlesbrough. Delivered prices in other zones are:—North-East Coast, 71s. per ton; Yorkshire, 75s. to 78s.; Scotland, 75s.; Lancashire, 76s.; Birmingham, 79s. per ton.

**LANCASHIRE.**—The foundry-iron trade is moving along on steady lines in this area. The general foundries are not particularly busy, but in certain specialised branches of the trade, such as machine tools, paper-making and rubber-making machinery, the outlook is quite favourable. The market is steady, with current offers of Staffordshire and Derbyshire brands of No. 3 foundry iron quoted for delivery to users in the Lancashire zone on the basis of 74s. per ton, Northamptonshire at 72s. 6d., Scottish foundry at about 82s. 6d., West Coast hematite at around 78s. 6d., and East Coast hematite at from 75s. to 76s., according to grade.

**MIDLANDS.**—Generally speaking, the foundry trade in this area is quite active, with the exception of certain works making castings for the building trade; the slackness in this section should soon disappear, however. Pig-iron prices are unchanged, the controlled rates delivered Birmingham and Black Country stations being 67s. 6d. for Northants No. 3 and 71s. for Derbyshire, Lincolnshire and North Staffs No. 3. These prices are all subject to a graduated rebate for such consumers as are eligible. Hematite is a quiet but steady market and there has been no change in prices, the controlled rates being £4 4s. 6d. for West Coast and £3 18s. for East Coast and Welsh hematite, delivered this area. A certain amount of new business has been placed and there is a steady demand for this class of iron for the engineering foundries.

**SCOTLAND.**—The foundries have now generally resumed work. Very little business has passed in Scottish foundry iron, the official quotation continuing at 70s. per ton for No. 3, f.o.t. furnaces, with 2s. 6d. extra for No. 1. The outlook in the light-castings trade is quite promising. The official quotations for Cleveland No. 3 iron remain at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow. Other English irons are quoted at 1s. 3d. per ton below these figures.

## Coke

So far there has been no change in foundry-coke prices, but it is generally agreed that a rise would have been seen had the weather not been so mild in recent months. Most foundries are well covered. In the Birmingham area, Durham coke is offered between 36s. and 40s. per ton, with cheaper grades obtainable at 1s. or so less. Welsh coke is quoted between 35s. and 45s. delivered Black Country stations. A certain amount of high-grade Scottish coke continues to come into the district, and this is quoted at 40s. to 42s. per ton.

## Steel

Business has developed on a satisfactory scale since the New Year, and there seems little doubt that the volume of trading during the first quarter will compare favourably with the last quarter of 1934. Quiet conditions continue to rule in the semi-finished steel department. Many consumers have arranged for their supplies for some weeks ahead, and are showing little interest in the market. On the other hand, comparatively few transactions are reported in Continental steel material, and most of the new business coming on the market goes to the British works. In the finished-steel department, active conditions have developed. Trading in most departments has reached the rate prevailing before the holidays, and shows indications of further expansion. The home demand is responsible for most of the business passing, but lately there has been an improvement on the export side.

## Scrap

There is an active demand for scrap iron, and quotations are generally firm. In the Cleveland area, prices are nominally unchanged at 53s. 6d. and 52s. 6d. per ton for good heavy machinery metal and cast-iron foundry scrap respectively, but an early advance is likely. There is a steady demand for cast-iron scrap in the Midlands, at unchanged prices. In South Wales, heavy cast iron is firm at 50s. to 52s. 6d., but there is only a limited demand from the local foundries for machinery scrap in cupola sizes, which is quoted at about 55s. per ton. In Scotland, sufficient supplies of cast-iron scrap are available to meet the steady demand.

## Metals

**Copper.**—This market continues to attract speculative interest, in view of the possibility of an international agreement being arrived at on restriction of output. Dealing on the London market has been quite active, but has now quietened down slightly. No definite news is yet forthcoming regarding the proposed conference in New York, apart from the fact that strenuous efforts are being made in some quarters to bring about a meeting, entailing much preliminary spade-work.

The Import Duties Advisory Committee is considering an application for an increased import duty on copper and copper-alloy tubes.

Daily quotations :—

*Cash.*—Thursday, £28 3s. 9d. to £28 5s.; Friday, £28 5s. to £28 7s. 6d.; Monday, £28 1s. 3d. to £28 2s. 6d.; Tuesday, £27 18s. 9d. to £28; Wednesday, £27 16s. 3d. to £27 17s. 6d.

*Three Months.*—Thursday, £28 11s. 3d. to £28 12s. 6d.; Friday, £28 12s. 6d. to £28 15s.; Monday, £28 10s. to £28 11s. 3d.; Tuesday, £28 7s. 6d. to £28 8s. 9d.; Wednesday, £28 3s. 9d. to £28 5s.

**Tin.**—Considerable interest has been taken in the tin market lately, as the result of last week's sudden jump in quotations, and an optimistic view is taken of the outlook. Rumour has it that the United States Government is in the market for heavy supplies of tin, as a preliminary to building up substantial "war reserves."

Messrs. Brandeis, Goldschmidt say :—"There has been no sign as yet that the 'buffer pool' interests intend to release metal for the purpose of re-establishing a more normal relationship between the spot and forward position, but, on the contrary, it looks as if they were attempting to profit by the heavy backwardation which is now prevailing."

Market fluctuations :—

*Cash.*—Thursday, £232 15s. to £233; Friday, £231 to £231 5s.; Monday, £230 10s. to £230 15s.; Tuesday, £230 12s. 6d. to £230 15s.; Wednesday, £230 5s. to £230 10s.

*Three Months.*—Thursday, £229 2s. 6d. to £229 7s. 6d.; Friday, £229 5s. to £229 7s. 6d.; Monday, £228 15s. to £228 17s. 6d.; Tuesday, £228 17s. 6d. to £229; Wednesday, £228 15s. to £229.

**Spelter.**—Although there is a tendency to hold back purchases until the result of the inquiry into the present import duty is known, there is quite a fair demand for zinc from galvanisers in this country, and also from India.

Official quotations :—

*Ordinary.*—Thursday, £11 17s. 6d.; Friday, £12; Monday, £12; Tuesday, £12; Wednesday, £11 17s. 6d.

**Lead.**—There is quite a good demand for lead, although the manufacturers are finding new orders rather scarce, as is usual at this season. The Empire producers are well sold for some time ahead.

Day-to-day prices :—

*Soft Foreign (Prompt).*—Thursday, £10 5s.; Friday, £10 6s. 3d.; Monday, £10 5s.; Tuesday, £10 5s.; Wednesday, £10 3s. 9d.

## Patent Specifications Accepted

*The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.*

417,411. MACNAUGHTAN, D. J. Production of adherent metal coatings upon iron, steel, or other metal.

417,799. ELLIS, E. [legal representative of ELLIS, R. E. (deceased)]. (United States Steel Corporation.) Chromium steels.

417,831. AKT.-GES. BROWN, BOVERI, ET CIE. Operation of flame-arc furnaces.

417,903. ANDERSON, G. Process for reduction of ores, and furnace for carrying out the process.

417,968. HAESSLER, P. [trading as PRÄZISIONSGUSS-FABRIK NÜRNBERG GEB. ECKERT]. Machines for casting metals under pressure.

418,296. ARNOLD, C. (Foundry Equipment Company). Furnaces.

418,298. A C SPARK PLUG COMPANY. Manufacture of alloys.

418,529. SINCLAIR, I. S., LAKIN, T., and WILD-BARFIELD ELECTRIC FURNACES, LIMITED. Temperature control of furnaces, ovens, and the like.

418,560. NORSK HYDRO-ELEKTRISK KVAELSTOFAKTIE-SELSKAB. Production of ferro-chromium free from carbon.

418,761. WILLIAMS, G. Casting metals.

### Anglo-Japanese Trade Relations Committee

The Federation of British Industries, as a result of the recent Mission to the Far East, has appointed a Committee to maintain contact with the Committee already appointed by the Japan Economic Federation in Tokyo.

The aims of the two Committees will be to consider jointly the problems affecting the general industrial relations between Great Britain and Japan, and to offer their good offices to any individual industries which may desire to enter into discussions, with a view to a solution of the problems which confront them.

The composition of the F.B.I. Committee is as follows:—Lord Barnby, chairman; Mr. R. W. Allen, chairman and managing director of W. H. Allen, Sons & Company, Limited; Sir Arthur Balfour, chairman and managing director of Arthur Balfour & Company, Limited; Sir George Beharrell, managing director of the Dunlop Rubber Company, Limited; Mr. D. Boyle, director of Andrews Toledo, Limited; Lord Cozens-Hardy, chairman of Pilkington Bros., Limited; Mr. J. L. Edmondson, secretary of the Federation of Calico Printers; Mr. Frank Farrell, President of the Silk Association; Mr. Guy Locock, director of the F.B.I.; Sir Harry McGowan, chairman of I.C.I.; Colonel Morcom, chairman of Belliss & Morcom, Limited; Mr. Julian Piggott, director of the British Steel Export Association; Sir Charles Seligman, senior partner of Seligman Bros., Limited; Mr. W. J. U. Woolcock, chairman of the F.B.I. Overseas Committee.

The secretary of the Committee will be Mr. W. V. Jenkins, 21, Tothill Street, S.W.1.

XUM

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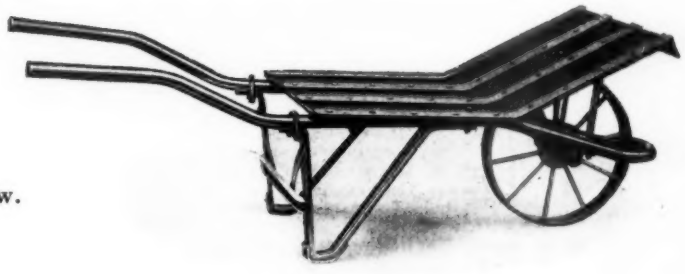
## ALL STEEL TUBULAR

# WHEELBARROWS

**ARE IDEAL FOR ALL FOUNDRY PURPOSES.**

**THEY POSSESS MANY IMPORTANT ADVANTAGES.**

No. 7 General Purpose Barrow.



No. 12 Pig Iron Barrow.

**A Sterling Product designed for hard work and built to last.**

**All parts are standardised and interchangeable for repairs.**

**Capacities from 2½ to 6 cubic feet.**

*Write for Booklet W.39.*

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*Telegrams:* "STERFLASK, BEDFORD."
*Code:* WESTERN UNION.

# RAW MATERIALS—PRICE LIST

**(Wednesday, January 16, 1935)**

## COPPER

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 27 | 16 | 3 |
| Three months | 28 | 3 | 9 |
| Electrolytic | 31 | 0 | 0 |
| Tough | 29 | 15 | 0 |
| Best selected | 30 | 5 | 0 |
| Sheets | 58 | 0 | 0 |
| India | 41 | 10 | 0 |
| Wire bars | 31 | 10 | 0 |
| Ingot bars | 31 | 10 | 0 |
| H.C. wire rods | 34 | 5 | 0 |
| Off. av. cash, December | 27 | 17 | 6 15/19 |
| Do., 3 mths., December | 28 | 5 | 4 1/19 |
| Do., Sttlmnt., December | 27 | 17 | 10 1/19 |
| Do., Electro, December | 31 | 6 | 4 1/10 |
| Do., B.S., December | 31 | 0 | 7½ |
| Do., wire bars, December | 31 | 11 | 0 1/10 |
| Solid drawn tubes | | | 9½d. |
| Brazed tubes | | | 9½d. |
| Wire | | | 6d. |

## BRASS

| | |
|---|---|
| Solid drawn tubes | 8½d. |
| Brazed tubes | 10½d. |
| Rods, drawn | 8d. |
| Rods, extd. or rlld. | 4½d. |
| Sheets to 10 w.g. | 7½d. |
| Wire | 7d. |
| Rolled metal | 6½d. |
| Yellow metal rods | 4½d. |
| Do. 4 × 4 Squares | 5½d. |
| Do. 4 × 3 Sheets | 5½d. |

## TIN

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 230 | 5 | 0 |
| Three months | 228 | 15 | 0 |
| English | 230 | 12 | 6 |
| Bars | 232 | 12 | 6 |
| Straits (nom.) | 232 | 0 | 0 |
| Australian (nom.) | | | — |
| Eastern | 231 | 10 | 0 |
| Banca (nom.) | 233 | 0 | 0 |
| Off. av. cash, December | 228 | 5 | 1 1/10 |
| Do., 3 mths., December | 228 | 11 | 7 14/19 |
| Do., Sttlmt., December | 228 | 5 | 0 |

## SPELTER

| | £ | s. | d. |
|---|---|---|---|
| Ordinary | 11 | 17 | 6 |
| Remelted | 13 | 5 | 0 |
| Hard | 10 | 15 | 0 |
| Electro 99.9 | 14 | 10 | 0 |
| English | 13 | 0 | 0 |
| India | 12 | 5 | 0 |
| Zinc dust | 17 | 0 | 0 |
| Zinc ashes | 3 | 0 | 0 |
| Off. aver., December | 11 | 17 | 5 23/26 |
| Aver. spot, December | 11 | 14 | 7 5/19 |

## LEAD

| | £ | s. | d. |
|---|---|---|---|
| Soft foreign ppt. | 10 | 3 | 9 |
| Empire (nom.) | 11 | 10 | 0 |
| English | 12 | 10 | 0 |
| Off. average, December | 10 | 8 | 1 17/19 |
| Average spot, December | 10 | 6 | 3 15/16 |

## ALUMINIUM

| | |
|---|---|
| Ingots | £100 to £105 |
| Wire | 1/1 to 1/9 lb. |
| Sheet and foil | 1/2 to 2/9 lb. |

## ZINC SHEETS, &c.

| | £ | s. | d. |
|---|---|---|---|
| Zinc sheets, English | 23 | 10 | 0 |
| Do., V.M. ex-whse. | 22 | 12 | 6 |
| Rods | 26 | 10 | 0 |

## ANTIMONY

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| English | 77 | 0 | 0 to | 78 | 0 | 0 |
| Chinese, ex-whse. | | | | 69 | 10 | 0 |
| Crude | | | | | — | |

## QUICKSILVER

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Quicksilver | 11 | 2 | 6 to | 11 | 10 | 0 |

## FERRO-ALLOYS AND STEEL-MAKING METALS

| | |
|---|---|
| Ferro-silicon— | |
| 25% | 8 17 6 |
| 45/50% | 13 0 0 |
| 75% | 18 7 6 |
| Ferro-vanadium— | |
| 35/50 | 12/8 lb. Va. |
| Ferro-molybdenum— | |
| 70/75% carbon-free | 4/6 lb. Mo. |
| Ferro-titanium— | |
| 23/25% carbon-free | 9d. lb. |
| Ferro-phosphorus, 20/25% | £14 10 0 |
| Ferro-tungsten— | |
| 80/85% | 3/- lb. |
| Tungsten metal powder— | |
| 98/99% | 3/3 lb. |
| Ferro-chrome— | |
| 2/4% car. | 29 15 0 |
| 4/6% car. | 23 0 0 |
| 6/8% car. | 21 12 6 |
| 8/10% car. | 21 12 6 |
| Ferro-chrome— | |
| Max. 2% car. | 34 0 0 |
| Max. 1% car. | 38 15 0 |
| Max. 0.70% car. | 42 0 0 |
| 70% carbon-free | 10d. lb. |
| Nickel—99.5/100% | £200 to £205 |
| "F" nickel shot | £184 0 0 |
| Ferro-cobalt, 98/99% | 5/3 lb. |
| Metallic chromium— | |
| 96/98% | 2/5 lb. |
| Ferro-manganese (net)— | |
| 76/80% loose | £10 15 0 to £11 5 0 |
| 76/80% packed | £11 15 0 to £12 5 0 |
| 76/80% export | (nom.) £9 15 0 |
| Metallic manganese— | |
| 94/96% carbon-free | 1/2 lb. |

Per ton unless otherwise stated.

## HIGH-SPEED TOOL STEEL

| | |
|---|---|
| Finished bars, 14% tungsten | 2s. 0d. |
| Finished bars, 18% tungsten | 2s. 9d. |

Per lb. net, d/d buyers' works.

| | |
|---|---|
| Extras— | |
| Rounds and squares, 3 in. and over | 4d. lb. |
| Rounds and squares, under ½ in. to ¼ in. | 3d. lb. |
| Do., under ¼ in. to ⅛ in. | 1/- lb. |
| Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. | 3d. lb. |
| Do., under ½ in. × ¼ in. | 1/- lb. |
| Bevels of approved sizes and sections | 6d. lb. |

Bars cut to length, 10% extra.

## SCRAP

| South Wales— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Heavy steel | 2 | 15 | 0 to | 2 | 16 | 0 |
| Bundled shrngs. | | | | 2 | 7 | 6 |
| Mixed iron and steel | 2 | 10 | 0 to | 2 | 12 | 6 |
| Heavy cast iron | 2 | 10 | 0 to | 2 | 12 | 6 |
| Good machinery | | | | 2 | 15 | 0 |
| **Cleveland—** | | | | | | |
| Heavy steel | | | | 2 | 11 | 6 |
| Steel turnings | | | | 1 | 15 | 0 |
| Cast-iron borings | | | | 1 | 5 | 0 |
| Heavy cast iron | | | | 2 | 12 | 6 |
| Heavy machinery | | | | 2 | 13 | 6 |
| **Midlands—** | | | | | | |
| Light cast-iron scrap | | | | 2 | 7 | 6 |
| Heavy wrought iron | | | | 3 | 0 | 0 |
| Steel turnings, f.o.r. | | | | 1 | 14 | 0 |
| **Scotland—** | | | | | | |
| Heavy steel | | | | 2 | 10 | 0 |
| Ordinary cast iron | | | | 2 | 11 | 0 |
| Engineers' turnings | | | | 2 | 0 | 0 |
| Cast-iron borings | 1 | 17 | 6 to | 1 | 19 | 0 |
| Wrought-iron piling | | | | 2 | 12 | 6 |
| Heavy machinery | | | | 2 | 15 | 0 |

London—Merchants' buying prices, delivered yard.

| | £ | s. | d. |
|---|---|---|---|
| Copper (clean) | 25 | 0 | 0 |
| Brass | 16 | 10 | 0 |
| Lead (less usual draft) | 9 | 10 | 0 |
| Tea lead | 6 | 10 | 0 |
| Zinc | 8 | 0 | 0 |
| New aluminium cuttings | 66 | 0 | 0 |
| Braziery copper | 20 | 0 | 0 |
| Gunmetal | 23 | 0 | 0 |
| Hollow pewter | 160 | 0 | 0 |
| Shaped black pewter | 118 | 0 | 0 |

## PIG-IRON

| | |
|---|---|
| N.E. Coast (d/d Tees-side area)— | |
| Foundry No. 1 | 70/- |
| Foundry No. 3 | 67/6 |
| „ at Falkirk | 67/3 |
| „ at Glasgow | 70/3 |
| Foundry No. 4 | 66/6 |
| Forge No. 4 | 66/6 |
| Hematite No. 1 | 69/- |
| Hematite M/Nos. | 68/6 |
| **N.W. Coast—** | |
| Hem. M/Nos. d/d Glas. | 72/6 |
| „ d/d Birm. | 84/6 |
| Malleable iron d/d Birm. | 115/- |
| **Midlands (d/d Birmingham dist.)—** | |
| Staffs No. 4 forge | 67/- |
| „ No. 3 fdry. | 71/- |
| Northants forge | 63/6 |
| „ fdry. No. 3 | 67/6 |
| „ fdry. No. 1 | 70/6 |
| Derbyshire forge | 67/- |
| „ fdry. No. 3 | 71/- |
| „ fdry. No. 1 | 74/- |
| **Scotland—** | |
| Foundry No. 1, f.o.t. | 72/6 |
| „ No. 3, f.o.t. | 70/- |
| Hem. M/Nos. d d | 71/- |
| **Sheffield (d/d district)—** | |
| Derby forge | 64/6 |
| „ fdry. No. 3 | 68/6 |
| Lincs forge | 64/6 |
| „ fdry. No. 3 | 68/6 |
| E.C. hematite | 81/6 |
| W.C. hematite | 83/6 |
| **Lancashire (d/d eq. Man.)—** | |
| Derby fdry. No. 3 | 74/- |
| Staffs fdry. No. 3 | 74/- |
| Northants fdry. No. 3 | 72/6 |
| Cleveland fdry. No. 3 | 74/- |
| Dalzell, No. 3 (special) | 102/6 to 105/- |
| Glengarnock, No. 3 | 82/6 |
| Clyde, No. 3 | 82/6 |
| Monkland, No. 3 | 82/6 |
| Summerlee, No. 3 | 82/6 |
| Eglinton, No. 3 | 82/6 |
| Gartsherrie, No. 3 | 82/6 |
| Shotts, No. 3 | 82/6 |

## FINISHED IRON AND STEEL

*Usual district deliveries for iron; delivered consumer's station for steel.*

| Iron— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Bars (cr.) | 9 | 12 | 6 to | 9 | 15 | 0 |
| Nut and bolt iron | 7 | 10 | 0 to | 8 | 0 | 0 |
| Hoops | 10 | 10 | 0 and up. | | | |
| Marked bars (Staffs) f.o.t. | | | | 12 | 0 | 0 |
| Gas strip | 10 | 10 | 0 and up. | | | |
| Bolts and nuts, ¾ in. × 4 in. | 14 | 0 | 0 and up. | | | |
| **Steel—** | | | | | | |
| Plates, ship, etc. | 8 | 15 | 0 to | 8 | 17 | 6 |
| Boiler plts. | 9 | 5 | 0 to | 9 | 7 | 6 |
| Chequer plts. | | | | 10 | 7 | 6 |
| Angles | | | | 8 | 7 | 6 |
| Tees | | | | 9 | 7 | 6 |
| Joists | | | | 8 | 15 | 0 |
| Rounds and squares, 3 in. to 5½ in. | | | | 9 | 7 | 6 |
| Rounds under 3 in. to ½ in. (Untested) | | | | 8 | 12 | 0 |
| Flats—8 in. wide and over | | | | 8 | 12 | 6 |
| „ under 8 in. and over 5 in. | | | | 8 | 17 | 6 |
| Rails, heavy | 8 | 5 | 0 to | 8 | 10 | 0 |
| Fishplates | 12 | 5 | 0 to | 12 | 10 | 0 |
| Hoops (Staffs) | | | | 9 | 7 | 0 |
| Black sheets, 24g. (4-t. lots) | | | | 10 | 10 | 0 |
| Galv. cor. shts. ( „ ) | | | | 13 | 0 | 0 |
| Galv. flat shts. ( „ ) | | | | 13 | 10 | 0 |
| Galv. fencing wire, 8g. plain | | | | 14 | 10 | 0 |
| Billets, soft | 5 | 10 | 0 and up. | | | |
| Billets, hard | 6 | 17 | 6 to | 7 | 2 | 6 |
| Sheet bars | 5 | 0 | 0 to | 5 | 7 | 6 |
| Tin bars | 5 | 2 | 6 to | 5 | 7 | 6 |

## PHOSPHOR BRONZE

| | Per lb. basis |
|---|---|
| Strip | 9d. |
| Sheet to 10 w.g. | 10d. |
| Wire | 11d. |
| Rods | 10d. |
| Tubes | 13d. |
| Castings | 10½d. |

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

## NICKEL SILVER, &c.

| | Per lb. |
|---|---|
| Ingots for raising | 7d. to 1/1 |
| Rolled— | |
| To 9 in. wide | 1/1 to 1/7 |
| To 12 in. wide | 1/1½ to 1/7½ |
| To 15 in. wide | 1/1½ to 1/7½ |
| To 18 in. wide | 1/2 to 1/8 |
| To 21 in. wide | 1/2½ to 1/8½ |
| To 25 in. wide | 1/3 to 1/9 |
| Ingots for spoons and forks | 7d. to 1/3½ |
| Ingots rolled to spoon size | 10d. to 1/6½ |
| Wire round— | |
| to 10g. | 1/4½ to 1/11½ |

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

## AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2 foundry, Phila. | 20.26 |
| No. 2 foundry, Valley | 18.50 |
| No. 2 foundry, Birm. | 14.50 |
| Basic, Valley | 18.00 |
| Bessemer | 20.76 |
| Malleable, Valley | 18.50 |
| Grey forge, Valley | 18.00 |
| Ferro-mang. 80%, seaboard | 85.00 |
| O.-h. rails, h'y, at mill | 36.37½ |
| Billets | 27.00 |
| Sheet bars | 28.00 |
| Wire rods | 38.00 |
| | Cents. |
| Iron bars, Chicago | 1.80 |
| Steel bars | 1.80 |
| Tank plates | 1.80 |
| Beams, etc. | 1.80 |
| Skelp, grooved steel | 1.70 |
| Steel hoops | 2.10 |
| Sheets, black, No. 24 | 2.40 |
| Sheets, galv., No. 24 | 3.10 |
| Wire nails | 2.60 |
| Plain wire | 2.30 |
| Barbed wire, galv. | 3.00 |
| Tinplates, 100-lb. box | $5.25 |

## COKE (at ovens)

| | |
|---|---|
| Welsh foundry | 25/- to 30/- |
| „ furnace | 19/- to 20/- |
| Durham foundry | 20/- to 25/- |
| „ furnace | 17/6 |
| Midlands, foundry | — |
| „ furnace | — |

## TINPLATES

f.o.b. Bristol Channel ports.

| | | |
|---|---|---|
| I.C. cokes | 20×14 per box | 18/2 to 18/6 |
| „ | 28×20 „ | 36/4 to 37/- |
| „ | 20×10 „ | 26/- to 26/3 |
| „ | 18¾×14 „ | 18/6 to 18/9 |
| C.W. | 20×14 „ | 15/6 to 16/6 |
| „ | 28×20 „ | 33/- to 33/6 |
| „ | 20×10 „ | 23/- to 24/- |
| „ | 18¾×14 „ | 16/- to 17/- |

## SWEDISH CHARCOAL IRON & STEEL

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Pig-iron | 6 | 0 | 0 to | 7 | 0 | 0 |
| Bars-hammered, basis | 16 | 0 | 0 to | 16 | 10 | 0 |
| Bars and nail-rods, rolled, basis | 15 | 15 | 0 to | 16 | 0 | 0 |
| Blooms | 10 | 0 | 0 to | 12 | 0 | 0 |
| Keg steel | 30 | 0 | 0 to | 31 | 0 | 0 |
| Faggot steel | 18 | 0 | 0 to | 23 | 0 | 0 |
| Bars and rods dead soft, st'l | 10 | 0 | 0 to | 12 | 0 | 0 |

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

**DAILY FLUCTUATIONS**

**Standard Copper** (cash)

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 28 | 3 | 9 | dec. 5/- |
| ,, | 11 .. | 28 | 5 | 0 | inc. 1/3 |
| ,, | 14 .. | 28 | 1 | 3 | dec. 3/9 |
| ,, | 15 .. | 27 | 18 | 9 | ,, 2/6 |
| ,, | 16 .. | 27 | 16 | 3 | ,, 2/6 |

**Electrolytic Copper**

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 31 | 10 | 0 | No change |
| ,, | 11 .. | 31 | 12 | 6 | inc. 2/6 |
| ,, | 14 .. | 31 | 5 | 0 | dec. 7/6 |
| ,, | 15 .. | 31 | 0 | 0 | ,, 5/- |
| ,, | 16 .. | 31 | 0 | 0 | No change |

**Standard Tin** (cash)

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 232 | 15 | 0 | inc. 15/- |
| ,, | 11 .. | 231 | 0 | 0 | dec. 35/- |
| ,, | 14 .. | 230 | 10 | 0 | ,, 10/- |
| ,, | 15 .. | 230 | 12 | 6 | inc. 2/6 |
| ,, | 16 .. | 230 | 5 | 0 | dec. 7/6 |

**Tin** (English ingots)

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 233 | 2 | 6 | inc. 20/- |
| ,, | 11 .. | 231 | 2 | 6 | dec. 40/- |
| ,, | 14 .. | 230 | 17 | 6 | ,, 5/- |
| ,, | 15 .. | 230 | 17 | 6 | No change |
| ,, | 16 .. | 230 | 12 | 6 | dec. 5/- |

**Spelter** (ordinary)

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 11 | 17 | 6 | No change |
| ,, | 11 .. | 12 | 0 | 0 | inc. 2/6 |
| ,, | 14 .. | 12 | 0 | 0 | No change |
| ,, | 15 .. | 12 | 0 | 0 | ,, ,, |
| ,, | 16 .. | 11 | 17 | 6 | dec. 2/6 |

**Spelter** (Electro, 99.9 per cent.)

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 14 | 11 | 3 | No change |
| ,, | 11 .. | 14 | 11 | 3 | ,, ,, |
| ,, | 14 .. | 14 | 12 | 6 | inc. 1/3 |
| ,, | 15 .. | 14 | 12 | 6 | No change |
| ,, | 16 .. | 14 | 10 | 0 | dec. 2/6 |

**Zinc Sheets** (English)

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 23 | 10 | 0 | No change |
| ,, | 11 .. | 23 | 10 | 0 | ,, ,, |
| ,, | 14 .. | 23 | 10 | 0 | ,, ,, |
| ,, | 15 .. | 23 | 10 | 0 | ,, ,, |
| ,, | 16 .. | 23 | 10 | 0 | ,, ,, |

**Lead** (English)

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Jan. | 10 .. | 12 | 10 | 0 | No change |
| ,, | 11 .. | 12 | 10 | 0 | ,, ,, |
| ,, | 14 .. | 12 | 10 | 0 | ,, ,, |
| ,, | 15 .. | 12 | 10 | 0 | ,, ,, |
| ,, | 16 .. | 12 | 10 | 0 | ,, ,, |

**Imports and Exports of Pig-Iron, Iron and Steel Castings, etc., in December and the twelve months, 1934, compared with a year ago.**

| | December. | | Twelve months. | | December. | | Twelve months. | |
|---|---|---|---|---|---|---|---|---|
| | 1933. | 1934. | 1933. | 1934. | 1933. | 1934. | 1933. | 1934. |
| | Tons. | Tons. | Tons. | Tons. | £ | £ | £ | £ |
| *Imports.* | | | | | | | | |
| Pig-iron, forge | — | — | 93 | — | — | — | 640 | — |
| ,, foundry | 3,432 | 4,063 | 37,680 | 30,785 | 14,763 | 12,430 | 137,877 | 90,210 |
| ,, acid | — | — | — | — | — | — | 226 | — |
| ,, basic | 3,900 | 6,503 | 79,477 | 79,477 | 10,435 | 18,589 | 147,666 | 221,465 |
| Total (including other kinds) | 7,332 | 12,284 | 93,086 | 125,715 | 25,198 | 40,712 | 286,409 | 400,665 |
| Castings and forgings | 20 | 297 | 993 | 3,736 | 578 | 8,942 | 22,293 | 98,520 |
| Cast pipes and fittings | 107 | 64 | 1,413 | 1,037 | 4,784 | 2,181 | 30,616 | 51,938 |
| Stoves, grates, etc. | 45 | 77 | 778 | 1,172 | 4,051 | 6,487 | 60,750 | 93,314 |
| Baths | 930 | 539 | 8,751 | 7,751 | 22,695 | 15,434 | 202,235 | 195,811 |
| Hollow-ware, all kinds | 490 | 115 | 3,033 | 2,230 | 16,730 | 8,493 | 117,753 | 131,631 |
| *Exports.* | | | | | | | | |
| Pig-iron, forge | 335 | 74 | 2,295 | 1,298 | 1,265 | 328 | 8,979 | 5,402 |
| ,, foundry | 5,737 | 5,436 | 51,735 | 73,426 | 18,805 | 17,968 | 178,313 | 251,419 |
| ,, acid | 4,476 | 4,558 | 52,235 | 47,910 | 14,102 | 14,567 | 162,828 | 151,417 |
| ,, basic | 400 | — | 1,722 | 842 | 1,386 | — | 6,491 | 2,796 |
| Total | 10,948 | 10,068 | 107,987 | 123,476 | 35,558 | 32,863 | 356,611 | 411,034 |
| Castings and forgings | 547 | 558 | 2,807 | 5,663 | 11,533 | 19,098 | 112,181 | 216,789 |
| Cast pipes and fittings, up to 6 in. diameter | 4,472 | 4,516 | 51,239 | 61,209 | 48,661 | 53,322 | 567,422 | 684,468 |
| ,, ,, ,, over 6 in. ,, | 3,568 | 2,800 | 35,254 | 37,047 | 33,868 | 26,290 | 263,537 | 283,305 |
| Stoves, grates, etc. | 674 | 846 | 6,847 | 8,935 | 36,047 | 45,735 | 338,735 | 441,750 |
| Sanitary cisterns | 254 | 249 | 2,751 | 3,025 | 7,616 | 7,256 | 80,725 | 87,829 |
| Bedsteads, inc. tubes therefor | 479 | 381 | 4,209 | 4,821 | 15,040 | 13,556 | 150,113 | 164,668 |
| Cast hollow-ware | 352 | 349 | 4,261 | 3,807 | 14,864 | 12,756 | 169,791 | 145,060 |


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ADVERTISER wants position as Foundry Works Manager or Foundry Superintendent with sole charge engaged in motor-car work or similar class of work, either alum. or iron or both. Up-to-date production in large quantities by machine, both moulding and cores. Able to introduce business. Guarantee results.—Box 106, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman seeks position; 17 years' experience with high-class work in ferrous and non-ferrous pressure castings; accustomed to modern plant, repetition work, moulding machines.—Box 118, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKS Manager and fully-qualified Chemist, with many years' management experience in manufacture and application of all classes of vitreous enamels, specialised in acid-proof enamels, requires change of appointment. Suitable post abroad not refused.—Box 114, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman required; good cupola control essential; knowledge of quick production methods for small castings; knowledge of white-heart malleable preferred; Sheffield district. State age, wage and experience.—Box 104, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

BOX 984, THE FOUNDRY TRADE JOURNAL, December 6, 1934.—Advertiser thanks all applicants for position of Foundry Foreman, which is now filled.

FOUNDRY MANAGER to take charge of large general engineering foundry in Glasgow area. Must have held a responsible position and have experience of both jobbing and production castings in iron, brass and other non-ferrous alloys. State full particulars.—Box 110, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGIST for Foundry (Slough).—Write, Box C.648, c/o JACKSON'S, 45, Fenchurch Street, London, E.C.3.

WANTED, Foreman for engineer's non-ferrous foundry. State age, experience and salary.—Box 112, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

### EMPLOYMENT REGISTER.

**Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.**

***Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.***

***Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.***

ASSOCIATE Member, I.B.F., requires position as Chief Accountant or Foundry Cost Accountant. Many years' professional and commercial experience. Incorporated Accountant. (253)

### AGENCIES

IRONFOUNDERS desirous of adding rainwater castings. Prospects excellent.—Communicate with Box 116, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

### AGENCIES—*Continued.*

A COMPANY with financial and manufacturing resources is willing to consider propositions from men with sound connections, for any speciality.—Write to Box 108, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

### MACHINERY

ONE New Ajax No. 12 Turnover, Jolt and Pattern Draw Moulding Machine, complete with self-levelling Bogie and Rails, Table 54 in. x 56 in., guaranteed, for £350.—JOHN MACDONALD & SON, Nitshill, Renfrewshire.

ONE Matthewson's Sand-blast Tumbling Barrel.—Apply, BLACKSTONE & COMPANY, LIMITED, Stamford.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

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Room Plants, sizes 12 ft. x 12 ft., 12 ft. x 9 ft. and 6 ft. x 6 ft., made up in cast-iron sections.

Barrel Plants, 30 in. dia. x 36 in. long and 30 in. dia. x 18 in. long rotary barrels.

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### MISCELLANEOUS—*Continued*

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'Phone: 287 SLOUGH

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406 OSBORN jolt rollover.
18"×36" TABOR rollover shockless (portable).
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Small Tilghman rotary table sandblast.

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